4.4 Impacts on the Social and Economic Environment

To help track potential impacts, this socioeconomic analysis is organized according to various socioeconomic components of the human environment that could be affected by the alternatives. The following (Table 4.4.1) is a list of the components and examples of the specific impact assessment variables that are considered.

Table 4.4.1. Socioeconomic Components of the Human Environment and Impact Assessment Variables.

Component of the Human Environment	Impact Assessment Variables
Incentives and disincentives regarding bycatch	The benefits and costs to fishers of avoiding and/or discarding fish
Commercial harvesters	Production levels of different sectors; ex-vessel revenues and operation expenses (average costs); distributional effects among commercial harvesters such as changes in level of dependence and involvement; effects on other fisheries.
Recreational fisheries	Value of the recreational experience; benefits and costs to charter/commercial operations.
Tribal fisheries	Fulfillment of subsistence needs; revenues and costs
Buyers and processors	Gross product revenues and operation expenses (average costs)
Communities	Employment and income
Consumers of groundfish products and other members of the general public	Product prices, quality and availability; non-consumptive and non-use values
Fishing vessel safety	At-sea fatalities and injuries
Management and enforcement costs	At-sea and dockside monitoring and enforcement costs; practicability and administration costs

Precise predictions of the associated effects of the bycatch reduction alternatives are not possible due to data limitations. Therefore, this socioeconomic impact assessment focuses on providing a qualitative description of the economic issues, the cause and effect relationships, and the direction and general magnitude of the anticipated economic impacts of each alternative.

To identify plausible and potentially significant impacts resulting from the alternative programs, this analysis relies heavily on best professional judgement of various economic analysts and fishery management professionals. The analysis draws on records of previous experience with similar NMFS and Council management actions as represented in other NEPA environmental reviews (EISs/EAs), peer-reviewed scientific journal articles, and other previously reviewed and screened documents. This reference literature summarizes existing knowledge of impacts based on accepted scientific standards. When it is possible

to draw potentially competing interpretations from the existing literature, the variations in the patterns of impacts and responses are described.

The analysis also relies on a limited number of informant interviews. These interviews were conducted with government agency personnel and other individuals familiar with the groundfish fisheries. This expert knowledge was used to supplement the available documentary record of the range of likely socioeconomic impacts of the management measures in each alternative and to determine how the effects of the alternatives considered are likely to deviate from those described in existing case studies and reports.

4.4.1 Social and Economic Impacts of Alternative 1 (No Action/Status Quo)

4.4.1.1 Effects on Fishers' Incentives to Reduce Bycatch

Under the current management regime, quota-induced discards can occur when fishers continue to harvest other species when the harvest guideline of a single species is reached and further landings of that species are prohibited. As trip limits become more restrictive and as more species come under trip-limit management, discards increase. In addition, discretionary discards of unmarketable species or sizes are thought to occur widely.

However, in comparison to a race for fish allocation system, the current management regime provides harvesters a considerable amount of flexibility to reduce unwanted catch and discards. The cumulative bimonthly trip limits effectively guarantee each limited entry permit holder access to his or her trip limit in each two-month period, and there is little that one fisher can do to directly affect the catch of others within that period.

In a typical race for fish situation, vessels compete with each other for shares of the overall quota of fish. Because cumulative trip limits have reduced the race for fish in the West Coast groundfish fisheries, fishers do not necessarily place themselves at a competitive disadvantage by adopting fishing practices that reduce the catch of unwanted fish (e.g., fish with low value or overfished species). For example, a vessel can take the time to move out of an area when it experiences high catches of unwanted species without the threat that other harvesters will cut into its share of the total quota. Similarly, taking shorter tows and sets to check for incidence of unwanted species does not penalize a vessel in terms of the amount of fish it may eventually catch. Finally, under the cumulative trip limit system a vessel can modify it gear and fishing strategies to reduce unwanted catches — for example, using smaller trawls or trawls with large mesh escape panels — without fearing that the possible reduced catch per effort will reduce its overall catch and revenue.

4.4.1.2 Effects on Commercial Harvesters

This section provides a brief overview of economic conditions of fish harvesters under the *status quo*. The overview describes the groundfish harvests in terms of landed pounds from major species groups and provides a brief summary of participation by limited entry and open access vessels in the groundfish fisheries through 2002.

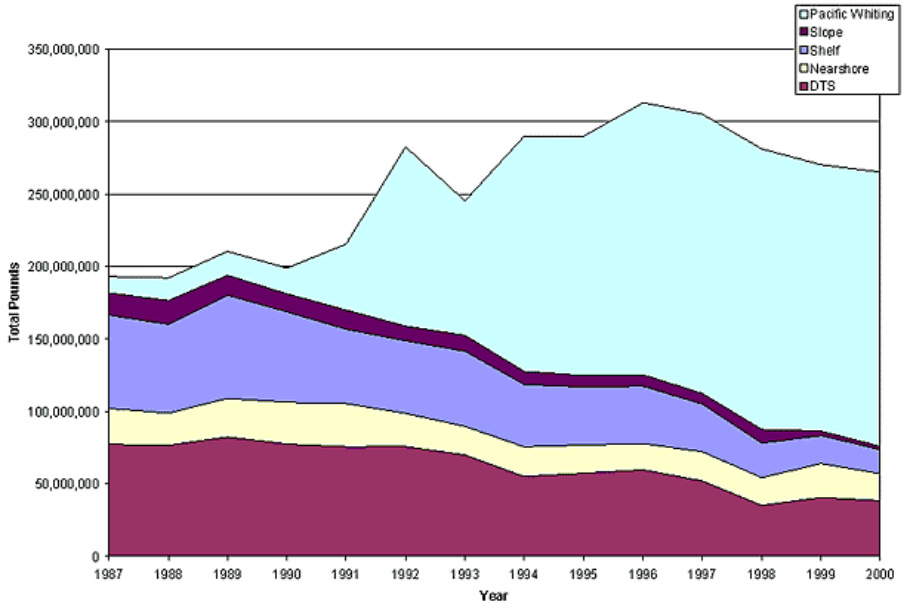
Table 4.4.2. Exvessel revenues in the groundfish fisheries (excluding the Pacific whiting fishery) by sector, 1999-2002.

Sector	1999	2000	2001	2002
	Exvessel Revenues ($1,000)			
Limited Entry Non-Trawl	9814	10946	8693	6852
Limited Entry Trawl	32,634	34,032	28,257	24010
Open Access (All)	7,762	8,732	8,254	7161
Total	**50,210**	**53,710**	**45,205**	**38023**

Source: Data provided by the Pacific Coast Fisheries Information Network (PacFIN, 11/2003).

Figure 4.2 illustrates the increase in total West Coast commercial groundfish

Figure 4.2. Landings in the groundfish fisheries by species group, 1987-2000. Source: PacFIN data 2003.



landings from 1987 to 1996 when landings peaked at over 300 million pounds. An important feature of this graphic is the increase in landings of Pacific whiting while landings of other West Coast groundfish (primarily rockfish and deepwater flatfish species) declined by nearly 50%. This steep decline in non-whiting groundfish landings has affected a much larger segment of the commercial groundfish fleet; only a few dozen vessels actively harvest whiting, while hundreds target other groundfish species. The decline in non-whiting landings has been driven by declining stocks of major target species, primarily several rockfish species that have been declared overfished.

The decline in landings of non-whiting groundfish has had a significant adverse economic impact on a number of harvesting sectors in the past. Table 4.4.2, which focuses only on the most recent years of 1999-2002, shows exvessel revenues in the West Coast groundfish fisheries increased in 2000 by 7% from 1999 levels, then dropped by 16% in 2001 and another 16% in 2002. The declines were greater in the limited entry sector than in the open access sector, with non-trawl revenues falling by a greater percentage than trawl revenues. The non-trawl sector targets higher-value species than the trawl sector (on average), and restrictions on shelf rockfish and sablefish hit that sector harder.

Decreased earnings in the groundfish fisheries have led to an overall decline in the number of vessels participating in the groundfish fisheries, but there are significant differences in participation trends across sectors. Figure 4.3 shows limited entry fixed-gear vessel participation from 1999 through 2002. During the four year period, the number of unique limited entry vessels participating in the groundfish fishery declined from 302 in 1999 to 204 in 2002 in response to various regulatory and resource changes. Reduced shelf rockfish trip limits and sablefish allocations were one cause. Declines in participation have been most noticeable during the summer months—in the July-August period the number of participating vessels declined from 242 to 142. The fact that participation in the shoulder seasons has not declined over the four year period suggests that the decline primarily involves part-time vessels, and that full-time vessels are continuing to participate. The establishment of a sablefish endorsement, the tier system, and ability of limited entry fixed gear vessels to stack permits have facilitated a reduction in fleet capacity.

Figure 4.3. Limit entry fixed-gear vessel participation by period and year, 1999-2002. Source: PacFIN data 11/2003.

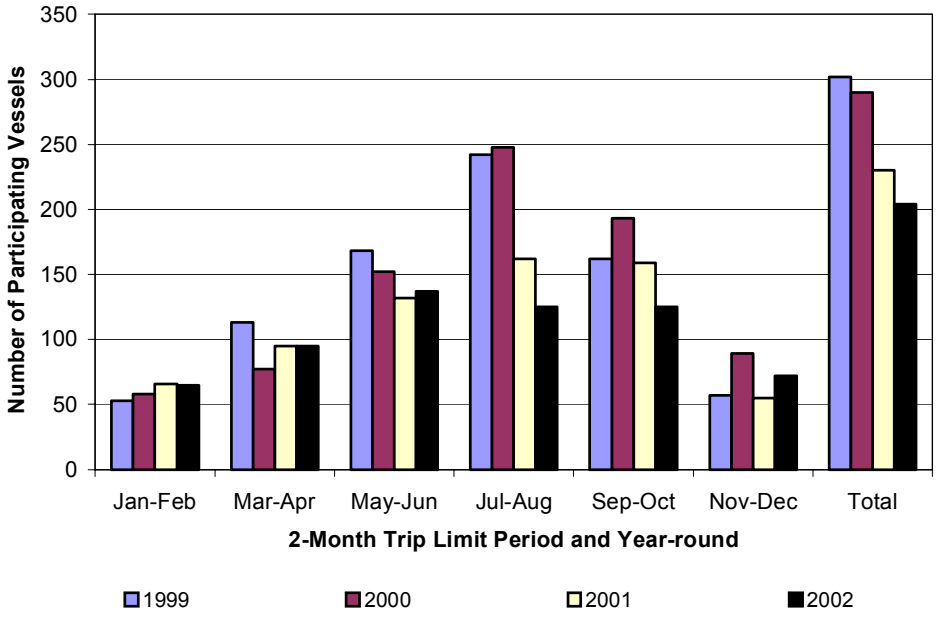
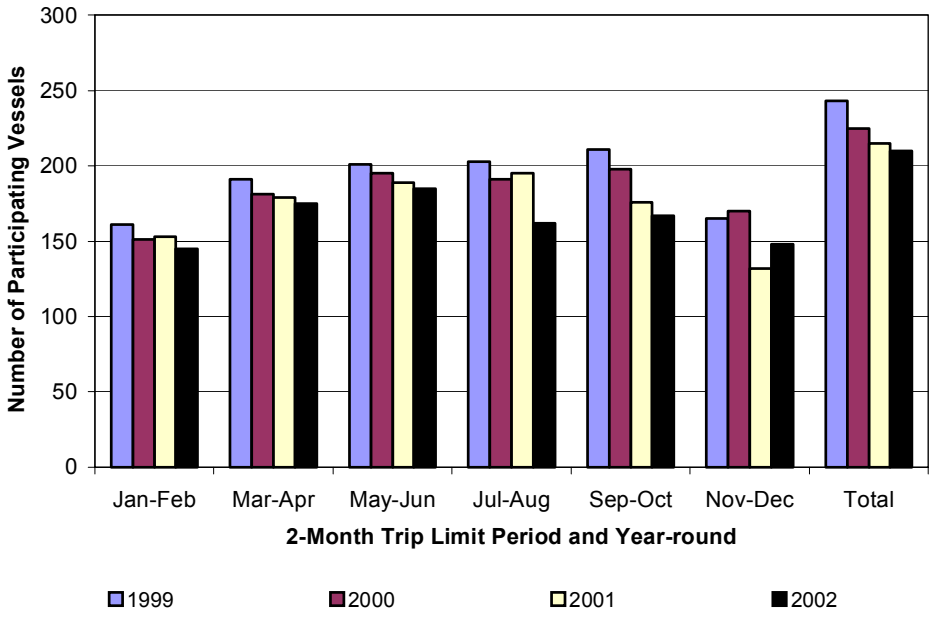


Figure 4.4 shows the participation pattern of limited entry trawl vessels, except those vessels participating exclusively in the Pacific whiting fishery.

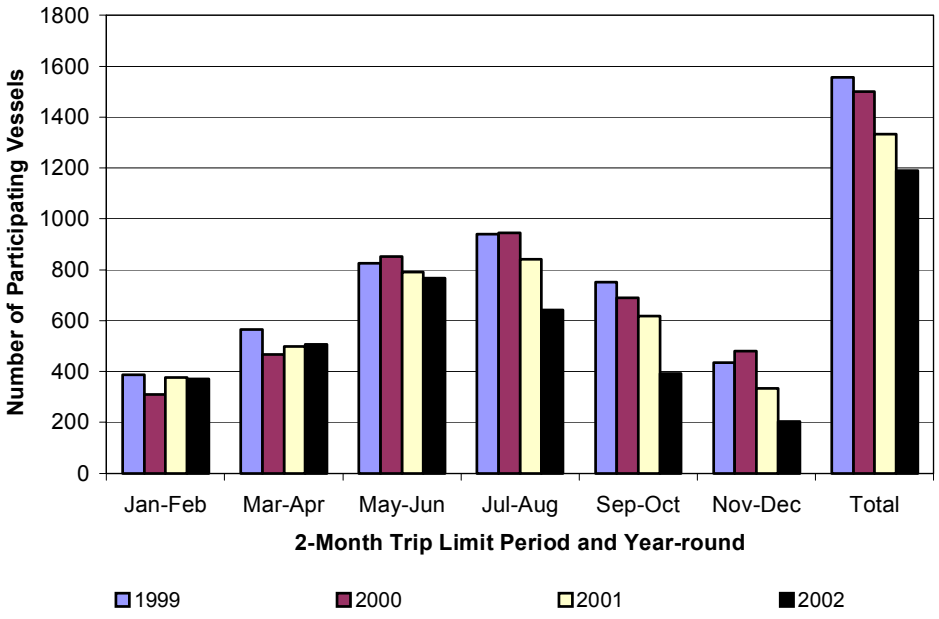
Figure 4.4. Limited entry trawl vessel participation by period and year, 1999-2002, excluding whiting-only vessels. Source: PacFIN data, 11/2003.



Participation by the non-whiting trawl sector is spread out more evenly over the six two-month periods in comparison to the participation seen in the fixed gear sector. While there has been a decline in participation by the non-whiting trawl sector during the four year period, the decline is relatively small. However, the trawl buyback program approved in late 2003 eliminated 92 trawl permits. This means a larger decrease is expected in 2004 and future years.

Figure 4.5 shows participation in the open access sector of the West Coast groundfish fisheries. The pattern here is similar to that seen in the limited entry fixed gear sector, with higher levels of participation during the summer months, but some level of participation throughout the year. Overall, the decline in participation is less pronounced than the decline seen in the limited entry fixed gear sector. Nevertheless, there has been a substantial movement of vessels in the directed open access sector into other fisheries or out of fishing altogether.

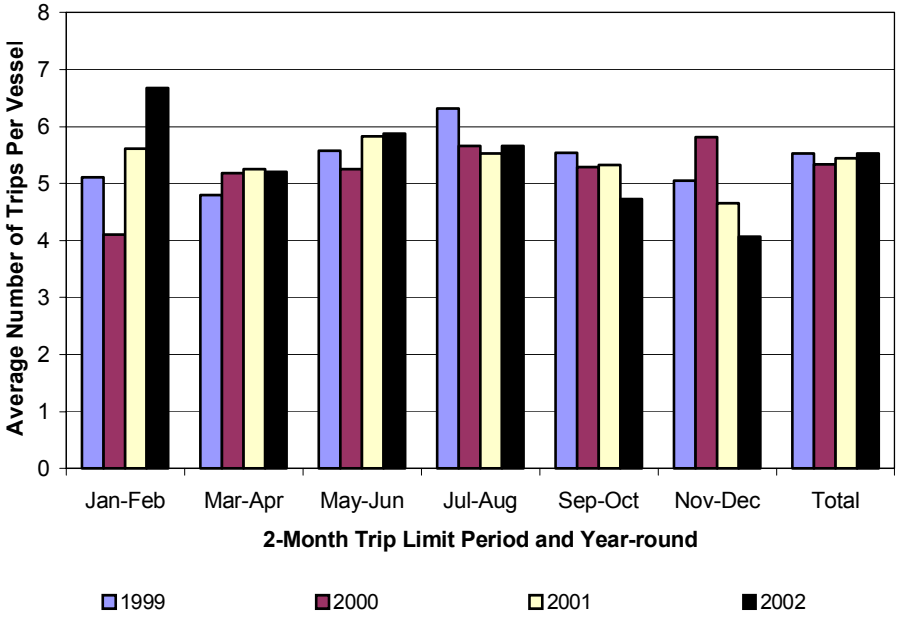
Figure 4.5. Open access vessel participation by period and year, 1999-2002. Source: PacFIN data 11/2003.



Despite the decline in the number of vessels participating in the groundfish fisheries, capital utilization rates continue to be low for all sectors of the commercial groundfish fishery. In 2000, analysts estimated that 9% of the limited entry fixed gear vessels could harvest all of their sablefish allocation and 12% of the vessels could harvest the non-sablefish components of the fishery (PFMC, 2000). For the limited entry trawl fishery, it was estimated that only about 27% to 41% of the existing fishing capacity was needed to catch and deliver the shoreside harvest, and 6% to 13% of the open access vessels could take that groundfish allocation.

Figures 4.4.6 - 4.4.8 show the average number of distinct fishing trips of vessels participating in the same three general sectors (limited entry fixed gear, limited entry trawl and open access) within each two-month trip limit period. The number of trips within each period may be an indicator of the effects of declining trip limits on participating vessels. It is presumed that, if the number of trips that vessels take within a trip limit period is low, there is a greater likelihood that discards will occur and that higher trip limits will lead to reductions in discards. For example, if vessels are able to take only one trip during the two-month period, it is likely that discards due to trip limit overages will occur for many of the

Figure 4.6. Average number of trips/landings per limited entry trawl vessel by period and year, 1999-2002. Source: PacFIN data 11/2003.



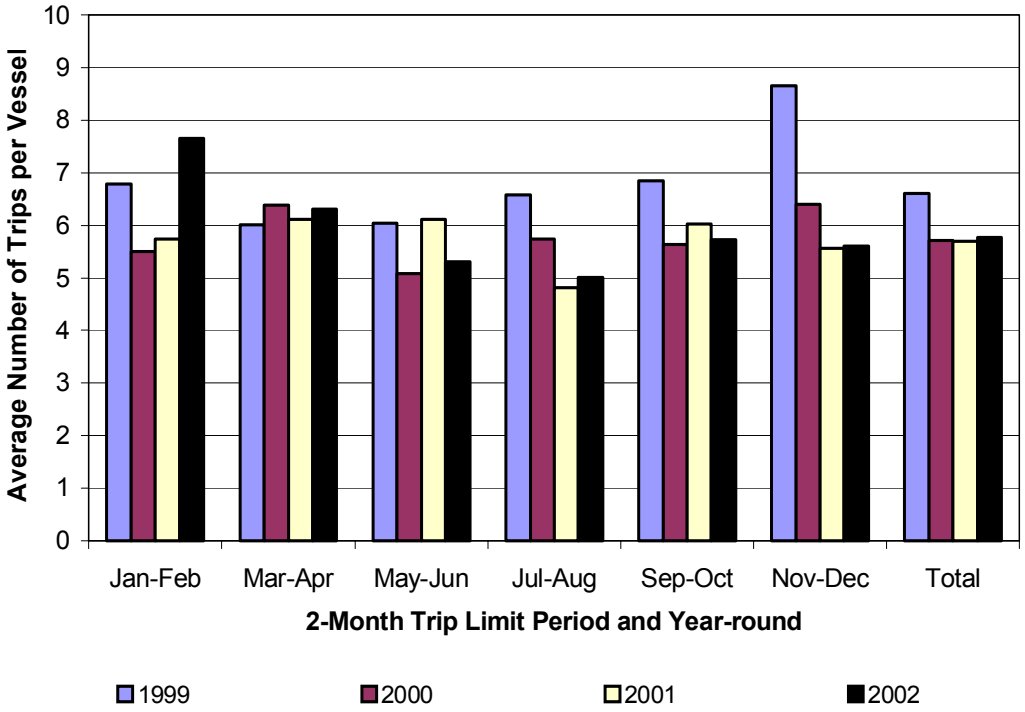
species. If vessels are making 3 or more trips during a period, discards due to overages may be a smaller percentage of total landings. In fact, the data show that in the limited entry sectors trips per vessels have remained relatively constant throughout the four year period — ranging in most cases between five and six for both sectors. While these data suggest that the amount of trip limits, particularly for target species, may not be a major factor leading to higher bycatch levels, additional analysis of trip level data of individual vessels is necessary before definitive conclusions can be reached.

In terms of projecting future socioeconomic effects of continuing the *status quo*, the general downward trend in landings, exvessel revenues, and vessel participation in the groundfish fisheries is expected to persist. Some displaced fishers may switch to non-groundfish fisheries. A substantial number of groundfish vessel owners already derive a substantial portion of their income from other fisheries. Many vessel owners and captains change their operations throughout the year, targeting on salmon, shrimp, crab, or albacore, in addition to

various high-value groundfish species, so as to spend more time in waters close to their communities (OCZMA, 2002). These fishers are likely to recover some portion of the revenue previously generated from groundfish fishing. However, many of these alternative fisheries are already fully exploited. Furthermore, it is probable that some displaced vessel owners will have difficulty relocating their operations given the limited access programs that have been implemented in West Coast fisheries and other U.S. fisheries. In addition, some boat owners may not be capable of shifting into other fisheries without significant additional capital outlays, while others may face increased costs and uncertain markets if they are forced to shift their operations away from the communities in which they live.

Given that opportunities for displaced fishers to recover their lost harvest and income may be limited, and that the groundfish fisheries are already characterized by limited profitability, it is likely that some displaced fishers will be forced to sell out or retire. It is uncertain how active the West Coast or nationwide market is for the types of vessels, gear, and other investment capital used in the groundfish fisheries. However, it is possible that the West Coast market for these assets could quickly be flooded, thereby depressing the immediate resale value of fishing equipment and vessels. Furthermore, the increasingly restrictive regulatory environment for groundfish fisheries may diminish the long-term investment value of the vessels and permits owned by displaced fishers who opt to continue fishing. This could create an economic hardship for those fishers who

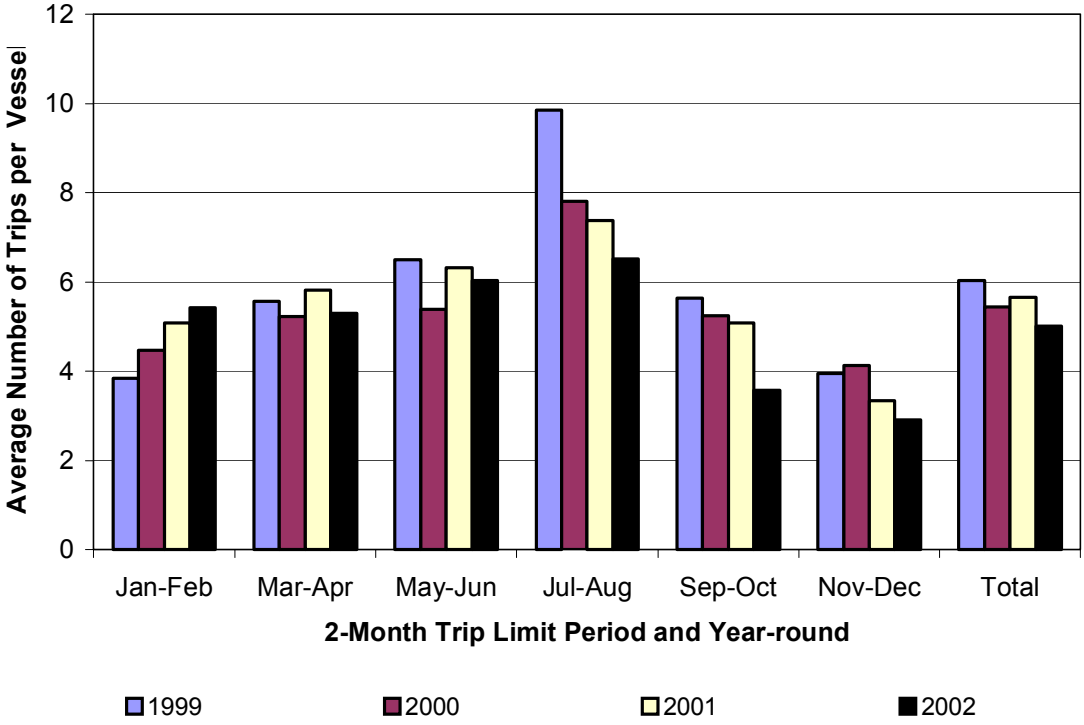
Figure 4.7. Average number of trips/landings per limited entry fixed gear vessel by period and year, 1999-2002. Source: PacFIN data 11/2003.



are relying on money earned from selling their fishing assets to supplement their retirement funds.

Transfer of effort from groundfish to non-groundfish fisheries could also indirectly create economic hardship in the form of reduced profitability for fishers already engaged in non-groundfish fisheries. The majority of fisheries along the West Coast and other areas of the U.S. are fully utilized. If fishers in the groundfish fisheries were to shift their effort to other fisheries, catch per unit of effort and individual harvest for non-groundfish fishers would likely decline due to the intensified fishing pressure on fish stocks.

Figure 4.8. Average number of trips/landings per open access vessel by period and year, 1999-2002. Source: PacFIN data 11/2003.



4.4.1.3 Effects on Recreational Fisheries

Recreational fishing has been part of the culture and economy of West Coast fishing communities for more than 50 years (PFMC, 2003d). Along the northern coast, recreational fishing traditionally targeted salmon, but rockfish and lingcod often provided a bonus to anglers. The estimated number of recreational marine anglers in Southern California was two and a half times the number in the next most numerous region, Washington state. While the bulk of recreational fishers in all areas were residents of those areas, a significant share were non-residents. Oregon had the greatest share of non-resident fishers at more than one-fifth of total ocean anglers (PFMC, 2003d).

Recreational fishing in the open ocean has generally been on an increasing trend since 1996; however, charter effort has decreased while private effort increased during that period (PFMC, 2003d). Part of this increase is likely the result of longer salmon seasons associated with increased abundance. Some effort shift from salmon to groundfish likely occurred around 1996, when salmon seasons were shortened in response to reduced salmon abundance. Groundfish are both targeted and caught incidentally when other species, such as salmon, are targeted. While the contribution of groundfish catches to the overall incentive to engage in a recreational fishing trip is uncertain, it seems likely that the possibility or frequency of groundfish catch on a trip adds to overall enjoyment and perceived value of the trip.

In terms of projecting future socioeconomic effects of Alternative 1, the general downward trend in recreational landings is expected to persist due primarily to the long-term nature of efforts to rebuild overfished rockfish stocks. This decline is expected to have a negative effect on the value of the groundfish fishing experience and may induce some anglers to either choose not to fish or to target other species. Opportunities for recreational fisheries to shift some of their effort away from groundfish resources towards other resources may be limited.

In recent years, recreational fishery catches and catch rates of some overfished groundfish (such as bocaccio) have greatly exceeded expectations, resulting in fishery closures for the first time. The validity of recreational catch estimates has been questioned, and the West Coast recreational fishery monitoring program has recently been modified to improve the precision and timeliness of recreational catch data. Data that become available over upcoming years could indicate that recent catch estimates have overestimated or underestimated recreational harvests, especially in California's large recreational fisheries. If recent recreational catches are determined to have been lower than previously believed, greater fishing opportunities would be likely in the future. If recent catches are found to be higher than previous estimates, recreational fishing opportunities could be further restricted. At this time, either scenario is plausible.

Another confounding factor is what has become known as the rebuilding paradox. As an overfished stock increases in abundance, it becomes more likely some of those fish will be caught, unless fishing effort is reduced. Depending on the particular rebuilding strategies, this could lead to even greater restrictions in the future. Given the data limitations and speculative nature of future management actions, it is impossible to quantify impacts.

4.4.1.4 Effects on Tribal Fisheries

Four Washington coastal tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish (PFMC, 2003d). The primary groundfish species targeted by Tribal fisheries are sablefish and Pacific whiting. Tribal fishers also take small amounts of black rockfish in their *USUAL AND ACCUSTOMED FISHING*

AREAS. The Tribes, NMFS, and the States have negotiated formal allocations for sablefish and Pacific whiting. In addition, the Tribes' anticipated black rockfish catches are acknowledged when the Council makes its annual harvest recommendations. There are also several groundfish species taken in Tribal fisheries for which the Tribes have no formal allocation.

In most recent years, Pacific whiting accounted for the bulk of tribal groundfish harvest tonnage (PFMC, 2003d). In 1999 and 2000, 32,500 mt of whiting was set aside for treaty Indian tribes of the U.S. OY of 232,000 mt for 2000. In 2001 and 2002, the whiting OY was reduced to 190,400 mt and 129,600 mt, respectively, and the tribal allocations for those years were also reduced to 27,500 mt and 22,680 mt, respectively. To date, only the Makah tribe has fished for Pacific whiting.

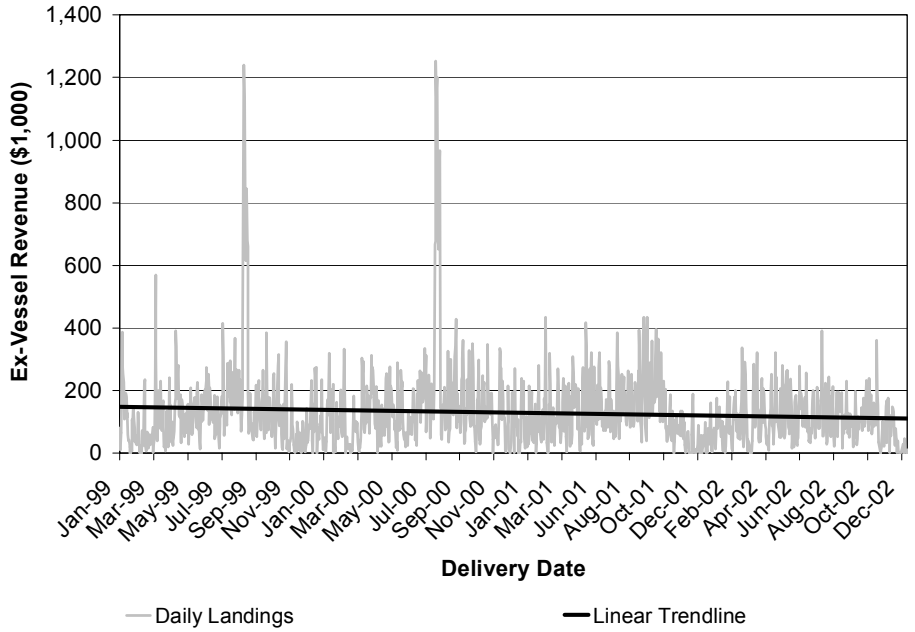
In terms of exvessel revenue, sablefish landings provided well over half of total tribal groundfish revenue each year, except 1998, 1999 and 2002 (PFMC, 2003d). Approximately one-third of the tribal sablefish allocation is taken during an open competition fishery. This portion of the allocation tends to be taken during the same period as the major tribal commercial halibut fisheries in March and April. The remaining two-thirds of the tribal sablefish allocation is split among the tribes according to a mutually agreed-upon allocation scheme.

The future socioeconomic effects of continuing the *status quo* on tribal fisheries are difficult to predict. The expected continuing downward trend in the OY specifications, especially for overfished rockfish, may result in smaller tribal groundfish opportunities. On the other hand, the sliding scale methodology used to determine the treaty Indian share of Pacific whiting is the subject of ongoing litigation (PFMC, 2003d). The outcome of this litigation and its subsequent effects on tribal participation in groundfish fisheries are uncertain.

4.4.1.5 Effects on Buyers and Producers

One of the primary goals of the West Coast Groundfish FMP is to ensure a steady flow of fish to buyers and processors throughout the year. This section examines flows of non-whiting groundfish to buyers and processors and attempts to determine the impact of two-month cumulative trip limits.
Figure 4.4.9. shows ex-vessel value of West Coast groundfish landings (excluding Pacific whiting) from 1999-2002. While the data reflect a general downward trend in revenues, they also show that there is a relatively steady overall flow of groundfish landings. In other words, the management regime appears to be relatively successful in maintaining a steady flow of product to seafood processors. It should be noted that fishery-wide data may mask variation in product flow to individual processors.

Figure 4.9. Value of Daily Landings of Groundfish (Excluding Pacific Whiting), 1999-2002. Source: PacFIN.



However, data also suggest that large buyers of groundfish have been hit hard by decreases in groundfish harvest. There was a 36% decline in buyer counts between 1995 and 2000 for those entities where groundfish was greater than 33% of their purchases and total purchases were greater than $10,000 (OCZMA, 2002). The number of buyers with total purchases greater than $1.5 million decreased by 56%.

The precipitous decline in the number of business entities is due both to reduced deliveries of groundfish and the overall consolidation within the processing industry (OCZMA, 2002). The buyer/processor sector has become quite concentrated, with approximately 5% of the buyers responsible for 80% of purchases (PFMC, 2003b). The largest buyers tend to handle trawl vessels more than smaller buyers. Of the 38 largest buyers of groundfish (those with purchases in excess of $1 million), 73% bought from trawl vessels.

This trend of consolidation in the processing sector is expected to continue. As the amount of target species delivered to buyers and processors continues to decline, we would expect higher average costs in this sector because of the reduction in the overall level of production. Fixed costs (i.e., costs that do not change with the level of production, such as loan repayments, general office and accounting expenses, and insurance costs) will be allocated to a smaller amount of product, thereby raising the average cost per unit of product. The variable

costs of processors and buyers may also increase under a continuation of the *status quo*, as the reduction in supply of fish is likely to put upward pressure on exvessel prices. These cost increases will be larger for those processors and buyers that are most dependent on groundfish. Smaller operations will probably be more affected by changes in landings than larger buyers because smaller buyers are relatively less diversified in the range of species handled. As average costs per unit of production rise, it is possible that they will exceed the value of production and lead to a temporary shutdown or permanent closing of some firms.

An additional problem that processors may face if landings decline is the maintenance of a skilled workforce (Parrish et al., 2001). Diminished work opportunities could diminish processors' ability to attract and maintain a skilled workforce. This could lead to either increased costs related to less efficient workers or additional expenditures to recruit or retain skilled workers.

4.4.1.6 Effects on Communities

The groundfish fisheries have historically provided West Coast commercial harvesters and processors with a relatively steady source of income over the year, supplementing the revenues earned from more seasonal fisheries. By maintaining year-round fishing and processing opportunities, the two-month cumulative trip limits have promoted year round employment in coastal communities. However, the downward trend in revenues caused by lower catch limits and area closures has had a significant negative economic impact on local businesses that are directly or indirectly involved in and are supported by the groundfish fisheries. In particular, the decrease in groundfish catches has had a direct and significant negative impact on individual fishing enterprises. Fishery participants have suffered from a loss of earning potential, investment value and lifestyle. Some fishing operations have been forced to change fisheries or leave the industry. The groundfish crisis has also had a significant effect on the shoreside part of the industry (Chambers, 2002). Included are individuals or firms that process, distribute, and sell fishery products, and enterprises that provide goods and services to the fish-harvesting sector, such as chandlers, gear manufacturers, boatyards, tackle shops, bait shops, and insurance brokers. While the percentage of business derived from the groundfish fisheries may be relatively small for some of these firms, any permanent loss of income during this extended period of stagnation in the U.S. economy could affect their economic viability.

On the other hand, when examined from a community frame of reference, the economic contribution of the harvesting and processing of groundfish fishery resources to the total economy of even small coastal communities is diluted by the relative scale of other economic activities, such as tourism and the wood products industry. Nevertheless, the finding that relatively few persons would be negatively affected economically, and the overall economy of a community would

not be significantly affected, does not lessen the economic hardship that reduced earnings or loss of a job would create for some fishers and their families.

Those who have become unemployed face the social and psychological costs of job loss. Individuals who lose their jobs typically experience heightened feelings of anxiety, depression, emotional distress, and hopelessness about the future, increases in somatic symptoms and physical illness, lowered self-esteem and self-confidence, and increased hostility and dissatisfaction with interpersonal relationships. In addition, both spouses and children of such individuals are at risk of similar negative effects. Families may find it difficult to pay bills and afford transportation, health care, and even food and clothing. The results of this financial strain may be high levels of psychological distress among some family members as well as an increase in physical health problems.

In addition to economic losses associated with declines in landings and revenues, there has been the loss of lifestyle to contend with. It is likely that enjoyment of the lifestyle or work itself is an important motivation for fishing among fishery participants. Moreover, some individuals may be motivated to fish for a living by a long-term family tradition. The loss of fishing-related jobs has caused some individuals to abandon the fishing lifestyle. A decrease in the economic viability of the commercial fishing lifestyle has, in turn, diminished the influence of local maritime culture in some communities. Groundfish fisheries are a historically important component of an industry that is deeply intertwined with the social and cultural resources of some coastal communities. For example, the Newport Beach dory fishing fleet, founded in 1891, is a historical landmark designated by the Newport Beach Historical Society.

It is also important to recognize that fishing communities are typically dynamic and continually adapting to change (Gilden, 1999). Despite reductions in groundfish fisheries, other substantial and well managed fisheries remain available to West Coast fishers: Dungeness crab, sardines, Pacific shrimp and albacore tuna (OCZMA, 2002). Many commercial groundfish fishers have already diversified their fishing operations to include these non-groundfish fisheries. Processors, wholesalers, distributors, and brokers are obtaining their groundfish from other sources or have looked for substitute products. This period of transition for the communities involved in groundfish fisheries has been eased by Congressional appropriations for economic adjustment and recovery programs. In 2000, for example, the Federal government appropriated $5 million in social services to the states of California, Oregon, and Washington to mitigate the effects of the groundfish crisis. While this level of government assistance is unlikely to continue, coastal communities are expected to continue to find ways to successfully adapt to contracting groundfish fisheries, although many more individual businesses involved in these fisheries will likely face economic hardship and possible bankruptcy.

4.4.1.7 Effects on Consumers of Groundfish Products

By spreading out fishing more evenly over the year, cumulative trip limits allow buyers and processors to provide a continuous flow of fish to fresh fish markets, thereby benefitting consumers and keeping consumer demand high. The decline in rockfish landings in the groundfish fisheries has probably had a minimal effect on consumers of groundfish products because of the availability of substitutes for West Coast groundfish products in the regional food distribution (PFMC, 2003d). Most supermarkets and restaurants do not rely on local supplies to stock their shelves or prepare menus (although some retail or restaurant patrons may place a premium on knowing the product they are purchasing is locally caught (Parrish et al., 2001)). Locally caught products that are no longer available are replaced with close substitutes obtained from elsewhere in the global supply chain. Although rockfish caught in West Coast fisheries are considered to be of high quality and are valued in West Coast fresh markets, similar products from South America, Mexico, Canada, or Alaska can substitute for West Coast production.

4.4.1.8 Effects on Fishing Vessel Safety

Some gains in fishing vessel safety are at least partially realized under the *status quo*. Cumulative landings limits provide fishers with the opportunity to fish at a more leisurely pace and avoid fishing in dangerous weather or locations. Low earnings on the part of individual harvesters limit funds for maintenance and safety equipment. Poor maintenance, bad weather, and a desperate need to fish may to lead to significant incidence of injury and losses in life and capital (Young, 2001). In addition, as revenues in the fishing industry decline, vessel owners and captains report it has become more difficult to find, hire, and keep qualified crew. While there are many skilled and capable crew members working on West Coast commercial fishing boats, many who once would have been attracted to the industry are discouraged by the apparent lack of a promising future. Conversely, the industry attracts people who are unable to find work elsewhere, and who lack the requisite skills and training. Some are itinerant, and do not stay long enough to be fully trained or invested in vessel operations—including safety (Gilden and Conway, 2000). To the extent that the groundfish crisis will deepen in the future, these negative effects on fishing vessel safety are likely to continue.

4.4.1.9 Effects on Management and Enforcement Costs

The current management regime results in a management process that is contentious, difficult and expensive. With an excessively large fleet and relatively restrictive management measures, violations are likely. Consequently, enforcement costs will be high. In addition, as fishers attempt to maintain a livelihood, they exert pressure to set harvest levels as high as possible and to allow fishing to continue as long as possible. The same pressures that induce managers to maintain high quotas create incentives for fishery scientists and concerned environmental advocates to urge for more precise stock assessments and catch monitoring. NMFS maintains a risk-averse management policy, which

means that greater uncertainty regarding the status or productive capacity of a stock or stock complex corresponds to greater caution in setting target catch levels. Reducing uncertainty requires more expensive data collection and analysis systems. NMFS and PSMFC spent nearly $6 million on these activities in 1999 (the states and PFMC spent additional money). NMFS estimates that it will need nearly an additional $13 million to satisfy its highest priority needs in responding to the current groundfish crisis. If granted, research and monitoring costs would increase to about $20 million, nearly half the value of the non-whiting groundfish fishery.

Several factors influence the cost of managing the West Coast groundfish fishery. NMFS conducts scientific surveys to track abundance trends for major groundfish stocks. The trawl logbook program is administered by the States of Washington, Oregon, and California, in conjunction with PSMFC. The States maintain the reporting system for commercial fishery landings and contribute to monitoring recreational groundfish catches. Commercial landings data are compiled in the Pacific Fishery Information Program, or PacFIN, and recreational statistics in the RecFIN program. The NMFS West Coast groundfish observer program contributes data on catch and discards, and state employees sample commercial landing to estimate species composition. This and other information is analyzed in comprehensive stock assessments prepared by federal, state, and academic scientists. An extensive stock assessment review process provides public and scientific peer review of these assessments. Much of the Council's meeting schedule is devoted to reviewing groundfish stock assessment information, developing harvest level recommendations, developing management measures consistent with harvest levels and goals and objectives of the groundfish FMP, and monitoring the pace of groundfish fisheries over the course of the year. Typically, information is scarce, which increases the amount of discussion, debate, and analysis relating to multiple management issues. The budgets of many state resource management agencies have been shrinking for several years, and federal funding for NMFS and the Council have not kept pace with the increasing complexity of the management program. Much of the complexity is the direct result of two fundamental policies: maintaining year-round fishing and marketing opportunities, and holding monitoring and other information costs as low as possible. For example, the recent trawl buyback program has eliminated 91 vessels from the fleet. The NMFS bycatch model tracks landings by every trawl vessel and projects how each vessel is expected to respond to changes in trip limits and other measures. Participation by vessels that remain in the fishery will undoubtedly change, in part due to increases in trip limits and in part due to changing ownership as some owners of eliminated vessels reenter the fishery by purchasing vessels that were not bought out. This will add an increased level of uncertainty and complexity in both the trip limit projections and bycatch projections until a level of stability is reestablished.

Technological developments are expected to mitigate the rate at which the management costs for the groundfish fisheries will escalate. For example, on

January 1, 2004, a Vessel Monitoring System (VMS) was implemented for the limited entry sector of the groundfish fishery. In other regions of the U.S., VMS has proven to be an effective, cost-saving technology for the monitoring and enforcement of large restricted areas over great distances. A VMS is an automated, real-time, satellite-based tracking system, operated by NMFS and the U.S. Coast Guard, which obtains accurate geographic position reports from vessels at sea. The cost of VMS transmitting units has decreased as new technologies have emerged. At this time, VMS transceiver units range in price from approximately $800 to $5,295 per unit, installed (PFMC, 2003e). The more expensive units allow two-way communications between the vessel and shore such that full or compressed data messages can be transmitted and received by the vessel.

VMS does not replace or eliminate traditional enforcement measures, such as aerial surveillance, at sea patrol boats, landing inspections, and documentary investigation (PFMC, 2003e). Traditional enforcement measures may need to be activated in response to information received via the VMS. However, VMS positions can be efficient in identifying possible illegal fishing activity and can provide a basis for further investigation by one or more of the traditional enforcement measures. In doing so, it makes certain activities of investigating officers more cost effective because less time will be spent pursuing false trails and fishing operators who are following the rules. Furthermore, VMS positions in themselves can also be used as the basis for an enforcement action.

Another major benefit of VMS is its deterrent effect (PFMC, 2003e). It has been demonstrated that if fishing vessel operators know that they are being monitored and that a credible enforcement action will result from illegal activity, then the likelihood of that illegal activity occurring is significantly diminished. VMS transmitters are required for all limited entry groundfish vessels as of January 1, 2004.

4.4.2 Social and Economic Impacts of Alternative 2 (Larger trip limits - fleet reduction)

This alternative examines the economic effects of increased trip limits achieved by reducing the number of trawl permits by 50% from the 2002-2003 level.

This alternative was developed based on the central theme of capacity reduction in the Council's *Strategic Plan for Groundfish*. In the time since this alternative was put forward, a major capacity reduction program has been implemented, reducing the number of active limited entry trawl permits by roughly 35%. This fleet reduction was in the form of a vessel buy-back program that eliminated the purchased permits and permanently prohibits those vessels from fishing anywhere in the U.S. Congress authorized a loan that the commercial groundfish industry must repay. The goal of reducing the fleet by 50% has not been fully achieved;

however, it is doubtful that another trawl fleet reduction program will be undertaken in the near future unless Congress authorizes additional funding.

This fleet reduction will have major effects on the economic and social conditions of the fishing industry throughout the West Coast, and most of those effects have not yet been observed. In many ways, this alternative is now much more similar to Alternative 1. It is not certain that cumulative trip limits will increase by the same percentage; new trip limits will be calculated based on the NMFS *BYCATCH MODEL* and will likely change over time as remaining vessels establish new fishing patterns. Thus, this buyback program does not fully equate to the fleet reduction measures proposed under Alternative 2.

4.4.2.1 Effects on Fishers' Incentives to Reduce Bycatch

Capacity reduction is usually pursued for reasons other than reducing bycatch, such as increasing the level of fishery profits (Pascoe, 1997). As such, effort reduction is generally not considered a bycatch management policy per se. However, reducing the level of effort in the groundfish fishery and increasing trip limits are likely to have substantial beneficial effects on the level of bycatch. In a study of West Coast groundfish, discard rates were found to vary inversely with the harvest amount of the trawl trip limits imposed (Pikitch, 1988).[1/] This finding suggests that if trip harvest limits were increased systematically with a reduction in fleet capacity, we should see a decrease in the rate of regulatory discards for overfished and target groundfish species. In addition, a reduction in the fleet size can help in developing interest in the fishery's future and in enabling fishers to deal collaboratively and constructively with bycatch problems (Young, 2001).

Generally, capacity reduction in most forms reduces the need for other controls that may lead to regulatory bycatch in particular. Non-regulatory bycatch of groundfish may also be reduced if there are fewer boats to supply market demands. If there are delivery limits imposed on harvesters by processors, the reduced number of vessels is expected to result in an increase in those limits.[2/]

4.4.2.2 Effects on Commercial Harvesters

The Council's Science and Statistical Committee estimates that the Pacific groundfish trawl fleet would need to be reduced by 60-90% to achieve maximum

1/ When the study by Pikitch (1988) was conducted, trip limits in the West Coast groundfish fisheries restricted landings for an individual fishing trip. It is likely that the study's conclusions apply to the current cumulative two-month trip limit, although this remains an empirical question.

2/ Processors may limit the amount of each species they are willing to accept in a given delivery in order to assure an even flow of product into the processing unit.

economic efficiency, where the marginal costs of production are equal to the marginal revenue. The Council endorsed a fleet reduction of at least 50% as a first step towards addressing overcapacity. This reduction would eliminate some (not all) of the extra capacity in the fishery and restore the fleet to some minimum level of profitability. In economic parlance, this implies that commercial harvesters would be able to capture at least some portion of their producer surplus or economic rent (which under the *status quo* has not been feasible). In part, this increase in profitability is derived from the reduction in excess capital and labor that is embodied in an overcapitalized fleet. If excess capital is removed from the fishery and trip limits are increased, we would expect to see increases in both average and overall net revenues to harvesters. The increase in trip limits would be expected to lead to increases in retention of fish caught. Higher catch levels (assuming prices remain constant) implies increases in revenues to harvesters remaining in the fishery.

Leipzig (2001) estimated that capacity reduction and the subsequent catch increase for the remaining participants could result in a 69.5% increase in exvessel revenues for the post-buyback trawl fleet. In addition, while overall total landings may stay the same, this alternative would lead to overall reduction in the variable costs to fishers. These cost savings are in part based on the reduction in the number of times an individual vessel catches its trip limit and is obliged to invest crew time in sorting and discarding fish caught over the limit.

NMFS estimates that for every $1.00 that fishers remaining in the fishery pay in buyback payment fees, they will receive $6.80 in additional revenue from the groundfish trawl fishery (Oregon State University, 2003). A trawl industry analysis prior to the buyback referendum (Leipzig, 2001) estimated a return of $22.42 for each dollar spent in fees. A hypothetical example illustrates how these estimates were derived. Suppose that a vessel in the pre-buyback fleet annually lands 200,000 lbs of groundfish, for which it earns $100,000 in exvessel revenue. The fixed costs and variable costs of the operation are $45,000 and $50,000, respectively. The net revenue of this vessels can be calculated to be $5,000. Now suppose that after the buyback the annual landings of the vessel increase to 400,000 lbs, and exvessel revenue increases to $200,000. The vessel's fixed costs remain at $45,000, and its variable costs double to $100,000. In addition, the vessel incurs a buyback repayment fee of $20,000. In this hypothetical example the vessel's net revenue grows to $45,000, nearly a 10-fold increase.

The magnitude of total economic benefits that could accrue to the Pacific coast trawl fishery from this alternative will also be affected by the distribution of vessels that retire and those that remain in service. As indicated in PFMC (2004), the number of vessels, vessel landings and ex-vessel values are unevenly distributed along the Pacific Coast. Therefore, if a predominance of vessels retires from areas of low ex-vessel value, net economic value increases to the fishery may be higher than would be the case if vessels were to retire in ports where ex-vessel values were relatively greater. This conclusion presumes that

there will be a shift in landings to areas where ex-vessel values are higher. In addition, the distribution of wealth among those remaining in the fishery and among the communities in which they reside will depend on where (in terms of what port) vessels are retired and where vessels remain.

4.4.2.3 Effects on Recreational Fisheries

Currently, most recreational fishing along the Pacific Coast targets nearshore groundfish species such as black rockfish, lingcod and cabezon. Proposed capacity reduction under Alternative 2 will largely affect shelf and slope fisheries, thus having a limited impact on stocks of fish most frequently targeted by the recreational fleet. As such, Alternative 2 is predicted to result in minimal impact on recreational effort and/or the quality of the trips taken relative to the *status quo*.

4.4.2.4 Effects on Tribal Fisheries

The Federal government recognizes Tribal treaty rights to fish for groundfish and other marine species. The Council fulfills its legal requirement by subtracting Tribal allocations and anticipated harvests before establishing non-tribal harvest allocations, trip limits and other management measures. The trawl fleet reduction program does not apply to tribal vessels. However, tribal fisheries for species other than whiting may be favorably affected if the buyback program results in fewer non-tribal trawl vessels operating in the tribes usual and accustomed fishing areas and fewer groundfish are taken from those areas. Any change from the *status quo* is predicted to be moderate at most.

4.4.2.5 Effects on Buyers and Processors

A reduction in excess fishing capacity and higher trip limits are not expected to significantly affect the total amount of fish that harvesters will deliver to processors. As a consequence, it is unlikely that we would see any price effect on producers (unless harvesters coordinate and, through collective bargaining, demand higher prices from processors). With fewer trawl vessels in the fishery, processors would have fewer boats to schedule for deliveries and offloading. The related reductions in time spent unloading vessels is expected to result in cost savings to the processors. On the other hand, the seafood processors in those ports that experience a reduction in fleet size may be negatively affected if they are unable to obtain supplies of fish from alternative sources. To ensure a steady supply of raw product, processors may bid up ex-vessel prices. Because processors operate in a global seafood market with many substitutes, it is unlikely they would be able to pass on their higher costs to consumers. Consequently, harvesters could capture some of the wealth that was previously retained by processors.

4.4.2.6 Effects on Communities

Depending on the geographic distribution of the remaining fleet, a fleet reduction may be a zero-sum game from the perspective of coastal communities: reduced landings and revenues in some ports may be matched by increases in landings and revenues in other ports (Schloz, 2003). The distribution of the post-buyback fleet under this alternative cannot be predicted because vessels will continue to respond to economic opportunities and management measures throughout the management area. Consequently, the direction and magnitude of many of the economic effects of this alternative on particular coastal communities are uncertain.

If a reduction in fleet capacity with higher trip limits is successful in increasing net revenues or profits to fishers, positive economic impacts on the communities where those fishers land their fish, home port, and reside are expected. As fishers' net revenues increase, we anticipate greater spending on basic goods and services. Increased spending on the part of fishers stimulates the local economy, generating more income, jobs and taxes within the communities. An increase in employment and income can also help avoid certain social costs. With higher trip limits, fishers may be employed more of the year so they may draw less unemployment compensation. In addition, instances of alcoholism and spousal abuse may decline, putting less strain on limited social service support networks (Young, 2001). In 2000, for example, the Federal government appropriated $5 million in social services to the states of California, Oregon, and Washington to mitigate the effects of the groundfish disaster. With improvement in the economic situation of individual fishers, such costs to society could be avoided to some degree (Young, 2001).

On the other hand, some communities may experience a significant reduction in fleet size and a consequent decrease in income, jobs, and taxes. These negative effects may be offset to some extent by the compensation that individuals leaving the groundfish fisheries receive from the buyback program. If these former groundfish fishers invest buyback funds in local businesses, additional economic growth may be generated in the community.[3/] However, if these individuals retire completely and leave the area, the economic impact on the community is likely to be negative.

4.4.2.7 Effects on Consumers of Groundfish Products

Because the decrease in fleet capacity is partnered with an increase in trip limits, it is assumed that total groundfish landings will not change significantly in comparison to the *status quo*. Under these conditions, we would expect to see

3/ In the short-run there may be an increase in social service costs while former participants adjust to their new economic situation.

little impact on consumers of groundfish because the price per unit would not likely change. Moreover, the demand for the two groundfish species most often purchased fresh (rockfish and sole) is highly elastic because there are numerous substitutes for these products. If the prices were to increase for these species, consumers would quickly switch to some other fish or protein product.

4.4.2.8 Effects on Fishing Vessel Safety

Fewer trawl vessels sharing the available harvest means average revenues per vessel will increase. Increases in net revenue to harvesters may lead to reductions in injury and loss of life relative to the *status quo* because of the harvesters' incentives to take fewer risks and use their best judgement in times of uncertain fishing conditions. In addition, higher earnings on the part of individual harvesters would increase funds for vessel maintenance and safety equipment.

4.4.2.9 Effects on Management and Enforcement Costs

A capacity reduction program results in a smaller fleet, and fewer vessels are generally easier and less expensive to monitor if the management of the fishery does not otherwise change. In addition, the fleet is expected to be more profitable — if fishing is profitable, fishers can afford investments in the future of the resource (Young, 2001). For example, they will not have the same incentives to push for maximum quotas as the current overcapitalized fleet does. A profitable fleet can also contribute to management, research and monitoring expenses that help assure the long-term stability of fishery resources. Finally, a smaller fleet may result in a certain amount of self-policing (such as is found in the current Maine lobster fishery). Self-enforcement could reduce to some extent the need for Federal and state enforcement programs.

However, the short term management costs borne by NMFS, the Council, and states would likely not be lessened by Alternative 2, and in fact certain costs would increase. For example, as described in the analysis for Alternative 1, fleet reduction has increased the uncertainty in the bycatch model at least in the near future. Further fleet reduction, as would occur under Alternative 2, would add to that uncertainty and increase management costs accordingly. As budget and personnel increases appear unlikely to keep pace, it is likely the cost will appear primarily as increased workload for agency personnel and the Council.

4.4.3 Social and Economic Impacts of Alternative 3 (Larger trip limits - shorter seasons)

This section examines the economic effects of the use of measures to reduce bycatch by reducing fishing time (shortening the season by 50%), thereby allowing for increased groundfish trip limits. In contrast to Alternative 2, Alternative 3 could be applied to all fishing sectors, including recreational and charter boats.

During the 1997 and 1998 annual management cycles, the Council considered the effects of and alternatives to the year-round fishery policy. The GMT prepared a number of reports and the issues were debated at length by the Council's advisory bodies, particularly the GAP. Several proposals would have revised the trip limit program by either shortening the entire season, establishing a series of shorter seasons, or setting different fishing periods for different vessels. After debating the pros and cons of the various alternatives, the Council decided to retain the policy and the use of trip limits to maintain fishing opportunities.

Recent data suggest that under the status quo, the average vessel makes only three to five fishing trips during a two month period (see Figures 4.4.5 - 4.4.7 in Section 4.4.1). If it is assumed that each fishing trip takes six days, a vessel that makes five trips in a two-month period is only active for 30 days (approximately 1 month) during that period. Therefore, it appears that the current management system leaves many vessels idle during each two-month period. Because vessels currently experience considerable down time during each two-month period, the economic effects of Alternative 3 will differ significantly depending on the way the fishing season is shortened. To clarify these differences, the analysis examines the effects of the following four possible subalternatives:

Subalternative 3a: One six-month fishing season - Condense the fishing year from 12 months to 6 months of continuous operations. Several options under this subalternative are possible — for example, groundfish fishing could begin in January and continue through June. Alternatively, fishing could begin in January and continue through March, then re-open in October and continue through December. The harvest amounts of cumulative two-month trip limits are assumed to double under this subalternative because the number of periods will be 50% of the number under the *status quo*.[4/]

Subalternative 3b: Two six-month fishing seasons - Split the fishing fleet into two groups and allow the first group to fish from January to June and the second group to fish from July to December. The harvest amounts of cumulative two-month trip limits are assumed to double under this subalternative because the number of potential participants in any given period will be 50% of the number under the *status quo*.

Subalternative 3c: Two fleets each with three two-month fishing periods - Split the fishing fleet into two groups and allow each group to fish in alternate two month periods. The harvest amounts of cumulative two-month trip limits are assumed to double under this subalternative because the number of potential participants in any given period will be 50% of the number under the *status quo*.

4/ Trip limits would increase, but it is unlikely they would double, because many vessel operate so far below their capacity. However, the assumption of doubling is used to simplify comparisons of the alternatives.

Subalternative 3d: Two fleets each with six one-month fishing periods - Split the fishing fleets into two groups and allow one group to fish odd-numbered months and the other group to fish even numbered months. The cumulative trip limits would be the same as under the *status quo*, but each vessel would have to catch its limit in half the time.

4.4.3.1 Effects on Fishers' Incentives to Reduce Bycatch

This alternative attempts to reduce bycatch by modifying the temporal pattern of fishing effort. As indicated in the analysis of Alternative 2, discard rates have been found to vary inversely with the harvest amounts of the trawl trip limits imposed (Pikitch, 1988; Methot et al, 2000). Higher trip catch limits result in less regulatory discards for overfished and target groundfish species because harvesters attain their trip limits fewer times in a given year. However, depending on the way that Alternative 3 would be implemented, higher trip limits may or may not occur. If Alternative 3 were implemented in a way that reduced the number of two-month periods in which any permit holder could fish (as in Subalternatives 3a-3c), cumulative two-month trip limits would likely to be higher, and discards would likely be reduced. If, however, the alternative were implemented so that every vessel could continue to participate in every two-month period (as in Subalternative 3d), higher trip limits would be unlikely and there may little reduction in bycatch. However, under all of the subalternatives it is likely that vessels would be able to increase the size of their landings per trip. Higher catches per trip would be expected to result in a lower percentage of discards relative to landed catch.

Some vessels may respond to the shortened groundfish seasons by shifting their effort to alternative fisheries rather than by increasing their effort during groundfish fishery openings. If this occurs, the level of bycatch may decrease due to a reduction in overall harvest levels.

Under Subalternative 3a, it is possible that market gluts could occur during the open months and/or existing processing capacity could be overwhelmed. These situations could drive down ex-vessel prices for certain species and/or lead to refusals by processors to take deliveries of certain species. The result could be an increase in economic discards, i.e., discards that occur even when cumulative landing limits are not attained.

4.4.3.2 Effects on Commercial Harvesters

A combination of higher trip limits and a 50% reduction in the length of the fishing season is expected to lead to an overall reduction in variable fishing costs. With larger trip limits, harvesters would be able to catch larger amounts of fish per trip. In addition, harvesters would be expected to discard a smaller percentage of total catch. The result would be a decrease in the average cost per

pound caught (assuming there is no difference in the catchability of fish in various months of the year).

However, the overall impact of this alternative on the costs and revenues of commercial harvesters depends on when individual participants are allowed to fish. According to PFMC (2003d), groundfish has historically provided West Coast commercial harvesters with a relatively steady source of income over the year, supplementing revenues earned from more seasonal fisheries. Although groundfish accounted for only about 17% of total annual exvessel revenue during 2000, groundfish played a more significant role on a seasonal basis, accounting for one-fifth to one-third of monthly exvessel revenue coast wide during April and the three summer months. Flatfish harvest supplied 3%-9% of monthly exvessel revenue throughout the year, and rockfish catch contributed an additional 2.5% - 6.8% to monthly exvessel revenue. Along the northern areas of the West Coast, groundfish has been particularly important just before the start of the December crab fishery. Seasonal closures could disrupt the traditional annual round of fishing activities, thereby reducing the profitability of fishing operations.[5/]

If there are seasonal differences in catchability, Subalternatives 3a-3c could have negative overall impacts on variable harvesting costs. For example, fishers may be unable to fish for certain species at optimal times. Industry sources indicate that several major target species form large aggregations at certain times of the year. Subalternative 3d would be more likely to avoid these negative seasonal effects because all vessels would have some fishing time throughout the year.

Under Subalternatives 3a and 3b, in which each vessel operates for six straight months, it is more likely that vessel operators would be able to be able to find gainful employment during the off season. An individual who is available for six straight months is more likely to be hired than someone with an on-again/off-again schedule as would occur under Subalternatives 3c and 3d.

Under Subalternatives 3b-3d, the opportunity exists for skilled crew members to double their incomes, because they could get positions on two different vessels during the year. However, the number of crew members that work on more than

5/ If current restrictions on limited entry permit ownership were relaxed, a number of options might become available that would mitigate the effects of Alternative 3 on commercial harvesters. For example, if permit stacking by trawl limited entry permit holders were allowed, a single permit holder and vessel could fish throughout the year. Another option would be for two permit holders to share a single vessel. The effect of this option on fleet size could be similar to that of Alternative 2 (except no buyback fees would have to be paid). Because one of the vessels could be retired or sold, fixed costs for the new operation would equal one-half the fixed costs of the two operations working independently. If all else were equal, the two permit holders could share the cost savings.

one vessel is likely to be equal to the number of crew members that will be unable to find positions on any groundfish vessel.

Under Subalternatives 3b-3d, it is also possible that trawl vessels would increase their participation in non-groundfish fisheries. For example, trawl vessel owners could increase their participation in the open access shrimp fishery during the periods in which they have no limited entry cumulative trip limits. Because there are groundfish bycatch issues in the trawl shrimp fishery, any reduction in bycatch in groundfish target fisheries that occurs under this alternative would be at least partially offset by increases in bycatch in the shrimp fishery.

4.4.3.3 Effects on Recreational Fisheries

The effects of shorter commercial seasons on recreational fishing opportunities is likely to be negligible because total commercial catch will not increase under this alternative. Alternative 3 is not intended to apply to the recreational fishery, but even if the scope of the alternative were expanded to include the recreational fishery, this fishery might not be significantly affected. Recent California state regulations have reduced its recreational groundfish season to as short as six months, and weather conditions in Oregon and Washington often limit the length of the recreational fishing season to around six months. Under Subalternatives 3a and 3b, the six-month closure of commercial fishing could occur opposite a six-month closure of recreational fishing. In this case, it is possible that the recreational fishing experience may be enhanced through higher catch rates.

4.4.3.4 Effects on Tribal Fisheries

The Federal government recognizes Tribal treaty rights to fish for groundfish and other marine species, and the Tribes, NMFS, states and the Council work to coordinate the groundfish management system. The Treaty Tribes typically manage their fisheries similarly to non-treaty fishing periods, with the exception of the Tribal sablefish and whiting fisheries. That is, Tribal regulations typically restrict Tribal hook-and-line vessels to trip limits very similar to those set for the non-tribal open access vessels. Likewise, Tribal trawl vessels are provided trip limits similar to limited entry trawl vessels trip limits. The Tribes are not required to manage in this way, and they might choose to concentrate their fisheries during periods closed to non-Tribal vessels off Washington. This could result in higher exvessel prices for Tribal fishers during those closed periods. However, given all the unknowns about the program design, any effects on Tribal fisheries from this alternative are predicted to be minimal.

4.4.3.5 Effects on Buyers and Producers

The effects of Alternative 3 on buyers and processors also depend on the way the closures are implemented. Increases in trip limits (as is possible with Subalternatives 3a-3c) and fewer vessels making deliveries during any period (as

is possible under Subalternatives 3b-3d) would likely have positive economic impacts on buyers and processors. A shortened overall fishing season (as would occur under Subalternatives 3a) could have a negative effect.

Larger trip limits are not expected to substantially affect the total amount of fish that harvesters deliver to processors, although it may be possible to capture a fraction of the total catch that is currently discarded. Any change would be unlikely to cause a price effect for producers. However, with vessels taking longer and potentially fewer trips, processors would have fewer boats to schedule for landings and unloading, reducing their average costs. On the other hand, depending on the timing and length of a particular platoon's seasons, a 50% reduction in the overall fishing season may result in increased costs to processors due to the fact that they may not be able to as easily control the flow of product throughout the year. Furthermore, processors may be leaving capital idle during the closed part of the year. A closure also has the negative effect of making it more difficult to re-hire filleters and other personnel when fish are again available. Moreover, buyers and processors may have difficulty maintaining markets if product is no longer available year round. Finally, the costs of starting up an idled plant, and shutting down an active plant are significant (BBEDC, 2003).

Another negative effect that a shortened season may have on processors is the flooding of the market for certain species when the season is open. The glut could overburden processing capacity and refrigeration/freezer space and result in waste due to spoilage. However, processing plants typically establish delivery limits to reduce the potential for such problems.

4.4.3.6 Effects on Communities

Community patterns of fishery participation vary seasonally based on species availability as well as the regulatory environment and oceanographic and weather conditions (PFMC, 2003). Consequently, the impact of this alternative on coastal communities is uncertain. If higher trip limits were successful in increasing net revenues or profits to fishers, positive economic impacts on the communities where those fishers land their fish, home port, and reside would be expected. As fishers' net revenue increases, greater spending on basic goods and services would be expected. Increased spending on the part of the fishers stimulates the local economy, generating more income, jobs, and taxes within communities. In addition, there would be a general sense of increased comfort and well being on the part of community members.

As indicated in the discussion of impacts on commercial harvesters, Alternative 3 (particularly Subalternatives 3b-3d) could result in a decline in the number of active crew members if the more skilled members seek to work full-time. Displaced crew members would be at least temporarily unemployed. Similarly, if there were a six-month seasonal closure, a large number of unemployed

groundfish crew members could flood the job market. To the extent that crew members remain unemployed during the closed season, they are more likely to be a drain on community social services.

4.4.3.7 Effects on Consumers of Groundfish Products

If Alternative 3 were implemented through the use of a six-month fishing and processing season (as under Subalternative 3a), there would likely to be a noticeable negative effect on some consumers of groundfish products. Consumers of fresh or live groundfish would be unable to obtain their fish from the same sources for half of the year. While it is likely that these consumers would be able to substitute other products for fresh groundfish, they would likely experience a decline in consumer surplus. On the other hand, if Alternative 3 were implemented by splitting the harvest sectors into two groups with one group of vessels active at any given time (Subalternatives 3b-3d), there would be few if any noticeable effects on consumers of groundfish products.

4.4.3.8 Effects on Fishing Vessel Safety

The effect of Alternative 3 on safety is uncertain because so much depends on the implementation method. Increases in net revenue to harvesters resulting from increases in trip limits would likely lead to reductions in injury and loss of life relative to the *status quo* because of harvesters' incentives to take fewer risks and use their best judgment in times of uncertain weather conditions. In addition, higher earnings on the part of individual harvesters increase their available funds for maintenance and safety equipment. On the other hand, set seasons make it more difficult for harvesters to make wise decisions as to when and where to fish. Seasonal closures can potentially force harvesters to venture out in extreme weather or take other undue risks. This could lead to greater incidence of vessel accident or personal injury. This could be offset to some extent by the reduced overall time a vessel would be at sea fishing for groundfish. Reduced fishing time means less time in potentially dangerous conditions. The adverse effects on safety of human life would be greater for smaller vessels.

If the outcome of this alternative were net declines in revenues in the fishing industry (due to the inability to fish for certain species at optimal times), vessel owners and captains could find it even harder to find, hire and keep qualified crew. While there are many skilled and capable crew members working on West Coast commercial fishing boats, many who once would have been attracted to the industry have become discouraged by the apparent lack of a promising future. Conversely, the industry may attract people who are unable to find work elsewhere and who lack necessary skills and training. Some such individuals are itinerant and do not stay long enough in the industry to be fully trained or invested in vessel operations, including safety. Such individuals are at greater risk of bodily harm to themselves and may unintentionally cause accidents by generally creating unsafe conditions.

4.4.3.9 Effects on Management and Enforcement Costs

The effects of Alternative 3 on management and enforcement costs are uncertain. If Alternative 3 were implemented with a six-month closure of all groundfish fishing and processing (as in Subalternative 3a), some management and enforcement costs would decline because there would be no fishing activity to monitor for 6 months of the year.[6/] Under Subalternatives 3b-3d there would be increased costs to assign permit holders to each group and to assure that groups that are off are not fishing illegally. These higher costs could be offset by the reduced number of vessels and trips that would need to be monitored at any given time.

The ability to predict vessel participation patterns would be greatly compromised by Alternative 3, regardless of which suboption were adopted. Calculation of trip limits would be more complex and contentious because vessel participation could not be accurately predicted. Also, accuracy of inseason monitoring and projections would deteriorate because historic fishing patterns would not provide useful comparisons for new fishing patterns. NMFS and the Council depend on the NMFS bycatch model to determine appropriate trip limits for the limited entry trawl fishery. The model requires an accurate anticipation of vessel fishing patterns for every trawl vessel. Management changes that disrupt fishing patterns erode the model's predictive power by increasing uncertainty.

4.4.4 Social and Economic Impacts of Alternative 4 (Sector catch limits- vessel caps)

This alternative would continue the use of cumulative *TRIP LIMITS* for non-overfished groundfish stocks (as under Alternative 1) but would specify *CATCH LIMITS* for *OVERFISHED* groundfish species. In addition, Alternative 4 would establish specific annual limits on the amount of overfished groundfish that could be caught by each sector. If a vessel reaches an RSQ limit during a period, it must stop fishing for the remainder of that period. If a vessel reaches the trip (retention) limit of a groundfish species that is not overfished, further landings of that species would be prohibited, but the vessel could continue to fish for other species. When a sector reaches an annual catch limit for an overfished species, further fishing by that sector would be prohibited for the remainder of the year. In short, each sector would be responsible and accountable for all overfished (or otherwise restricted) groundfish caught. Nine fishing sectors are identified under the current regulations: limited entry trawl; limited entry longline; limited entry pot; three whiting sectors (catcher processors, motherships and shore-based); open access; tribal; and recreational. However, these sectors could be subdivided

6/ Under Subalternative 3a there is a possibility of increases in illegal fishing activity and the creation of a black market for valuable groundfish species. This could lead to increases in monitoring and enforcement costs.

to create additional sectors. For example, some sectors may be subdivided by geographical area or target species/species group.

4.4.4.1 Effects on Fishers' Incentives to Reduce Bycatch

Under this alternative, every limited entry vessel could continue to discard, but unlike the *status quo*, any overfished groundfish discarded would be recorded and counted against the vessel's catch limit for the period and the sector's annual catch limit. When a sector limit is reached, all vessels in that sector would have to stop fishing for groundfish for the remainder of the year (or until allowed to start again). Under this alternative one sector's harvest in excess of a limit does not affect the fishing opportunity of other sectors. However, the catch of overfished species by individual vessels within each sector can negatively affect other vessels in the sector. For example, a single disaster tow of an overfished species, if observed, could cause an entire sector to be shut down. In this situation, a race for fish could develop in which unobserved vessels eschew fishing practices that reduce bycatch in order to attain their landing limits as quickly as possible. However, observed vessels could have larger trip limits for non-overfished groundfish and would thus have incentive to carry an observer, even at its own expense.

Under this alternative, it is clearly in the best interest of all vessels within a sector to reduce the catch of overfished species. However, in the absence of individual limits, there may be economic factors that reduce the incentive of individual vessels to undertake actions to be more selective in what they catch. A vessel captain who undertakes actions to reduce bycatch bears the full costs of deploying more selective gear and searching for cleaner fishing grounds. While some benefits of minimizing the capture of unwanted fish (e.g., less handling time) accrue solely to the individual that incurs these costs, the benefits of avoiding closure of the fisheries to the sector are spread across all vessels. The free-riders that did not adopt more selective fishing methods (or even eschew bycatch reduction methods they use under the *status quo*) may develop a competitive advantage over those that do by incurring fewer operating costs and/or increasing their share of the catch limit. If the free-rider problem resulted in a noticeable redistribution of profits across the sector, no one would be motivated to continue to invest in fishing practices that reduce the catch of overfished species and other unwanted fish. However, only unobserved vessels could be free riders. By establishing individual vessel caps for overfished species, vessels have much greater incentive to avoid those species. The provision for individual vessel caps for overfished species was not initially included in this alternative but was added to increase the effectiveness (and therefore the acceptability) of this alternative. Without this provision, an observed vessel could close a sector just by continuing to fish and discard after reaching his trip limit for an overfished species. In the absence of vessel caps, vessels would be expected to move away from high bycatch areas, and peer pressure could be exerted on those who are reluctant to move. However, without formal constraints, there is always the temptation to

bend the rules. If some vessels contribute to the joint bycatch reduction effort while others free-ride, the provision of the collective benefit is less than optimal (Ostrom, 1990). Individual caps for overfished species should effectively prevent the free rider issue, allowing cooperative patterns of behavior to emerge. For example, vessel owners and captains within a particular sector may be more willing to exchange fishing information, such as the location of bycatch hotspots (Gauvin et al., 1996).

The free rider problem would be less in sectors that consists of a relatively small number of participants with common interests, such as the whiting catcher-processor fleet. In such situations, negotiation of voluntary cooperatives might be feasible. The formation of cooperatives could further facilitate collective efforts by industry to reduce bycatch. For example, contractual arrangement among cooperative members may restrict the harvest of target species in areas of high bycatch to member vessels with low bycatch rates as an incentive to promote cleaner fishing practices. Cooperative members could rely on civil law to enforce contract terms. The catcher-processor sector of the Pacific whiting fishery currently uses a cooperative structure to limit salmon bycatch and actively shares information on incidental catch of other species as well.

An added economic incentive for fishers to take collective action to fish more selectively under this alternative is that a portion of the groundfish OY would be reserved for the sector (or sectors) with the lowest bycatch.

4.4.4.2 Effects on Commercial Harvesters

Close monitoring of sector caps for overfished species could further constrain harvest of co-occurring other groundfish, especially if sector participants ignored incentives and did not apply bycatch-reducing fishing tactics. A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. On the other hand, healthy stocks could be more accessible if sector bycatch reduction efforts were successful. More desirable species such as yellowtail rockfish are often harvested below cumulative catch limits due to constraints associated with overfished species.

The expanded observer coverage would impose significant additional operating costs on vessel owners, especially if observers carried by vessels under this alternative are funded by a pay-as-you-go system similar that for the processing vessels in the Pacific whiting fishery. In a pay-as-you-go system, the vessel owner is responsible for making arrangement with an observer employment firm, which provides the required observer services, and for paying all associated costs (PFMC, 2003e). Even if the direct costs of increased observer coverage are paid by NMFS, vessels may incur substantial indirect costs. At a minimum, it is likely that observer food costs will be borne by the vessel. Limited bunk space may require vessel operators to reduce the number of crew in order to accommodate observers, resulting in a decrease in the operating efficiency of the remaining

crew. Vessels may also incur costs if they choose to carry additional liability insurance. These costs would vary between individual vessels depending on the insurance carriers' minimum allowed coverage period, and the coverage approach that is taken (PFMC, 2003e).

It is likely that the smallest groundfish vessels would be most affected by the observer requirement (PFMC, 2003e). It may be determined that some vessels are simply too small to accommodate an observer. Unless these vessels were exempt from the observer requirement, they would have to end their participation in the groundfish fisheries. Similarly, vessels with the least revenue may be excessively burdened if required to carry an observer over an extended period of time. Electronic monitoring technology, such as the installation of tamper-proof video cameras on board vessels to record activities at sea, has the potential to substantially reduce the costs of monitoring catch and discards (Appendix C). However, further testing of the effectiveness of this type of electronic monitoring technology is needed before it can be adopted as a lower cost alternative to at-sea observers.

The economic effects of this alternative on commercial harvesters may also vary by sector, depending on the mechanism for allocating catch limits. For example, managers may consider gear impacts, efficiency and other factors in determining the percentage allocation of harvest for each sector. Sectors consisting of vessels that use relatively clean fishing methods and generate overall gains for the fisheries (e.g., produce a higher value product, have a lower impact on juvenile stocks, result in minimal habitat disturbance) could receive a larger allocation.

Such preferential allocations may induce each sector to engage in rent-seeking behavior. Lobbying efforts to acquire the maximum allocation possible may be costly. For instance, fishers may sacrifice even more valuable fishing time to attend Council meetings, and industry associations may acquire the services of lawyers and lobbyists to help the association influence decisions on the allocation of catch limits (Anderson, 1992).

The allocation of catch limits to individual sectors could lead to cooperative patterns of behavior besides those directly related to reducing bycatch. In particular, sector members may form private agreements allocating transferable harvesting privileges as was done by catcher processors in the Pacific whiting fishery. The allocation of transferable privileges through private agreement generates benefits for commercial harvesters similar to those that might be generated under an individual transferable quota (ITQ) program (See Alternative 5 effects on commercial harvesters). Unlike ITQs, however, the distribution of fishing privileges and the system for trading, selling, or enforcing them is decided by the parties to the agreement.

Sullivan (2000) states that the ability to negotiate private agreements allocating harvesting privileges depends on certain conditions being met, including 1) a

relatively small number of participants, with a sufficient community of interest to make negotiations feasible; 2) an adequate system for gathering fishery harvest data, and adequate data verification and transparency to monitor compliance and enforce it in cases of non-compliance; 3) significant barriers to prevent new participants from entering after shares have been negotiated, or else free riders are almost certain to be predators on the fishermen who rationalize their harvest; 4) an opportunity to attain additional value through an allocation agreement; and 5) for antitrust law reasons, when the arrangement includes one or more vertically integrated producers operating in a U.S. fishery, assurance that the relevant fishery sector's target species or incidental catch allocation(s) will be limited and fully harvested.

Once an agreement is negotiated, the parties to the agreement must have internal rule-making capability and sanctioning authority to deter those who are tempted to break the rules (Ostrom,1990). Quota shares could be created by using contracts and relying on civil law to enforce contract terms, including penalties (e.g., expulsion from the agreement) for vessels that exceed their quota holdings.

Leal (2002) states that one advantage private harvesting agreements have over an ITQ program is avoidance of the expensive rent-seeking behavior that often accompanies allocation of ITQs. Although this process may not be free from controversy, it appears to be easier for the individual participants to allocate individual shares than to have the government do it. On the other hand, Leal (2002) notes that private harvesting agreements may also have some disadvantages in comparison to ITQs. A new entrant can simply buy or lease ITQs from a quota owner willing to sell or lease. In contrast, with a private harvesting agreement, the transfer of shares to a new entrant will require becoming a party to the agreement. In addition, ITQs are likely to remain in force, especially once they acquire value through the secondary market. By contrast, the durability of private agreements depends on the willingness of parties to maintain the agreement. Even when the arrangement has no sunset provisions, or requires a majority of members to rescind it, members may not retire as many redundant vessels or invest in as much of the product enhancement capital as they would under a system of ITQs.

The cooperative patterns of behavior that may develop under this alternative are expected to generate economic benefits for commercial harvesters. These benefits may render some commercial harvesters better able to sustain the costs of an observer requirement. In addition, increased observer coverage may allow more vessels to process seafood products at sea. State fishing regulations do not allow at-sea processing of any groundfish except Pacific whiting. On June 7, 2004 (69 FR 31751), NOAA Fisheries finalized a rule that requires all at-sea processors to carry and pay for observers. It is uncertain whether the presence of observers will lead to a relaxation of state restrictions on at-sea processing. If it does, investments in freezing capacity could lead to significant increases in revenues for some vessel owners (OCZMA, 2002). For example, sablefish

commands substantially higher prices when frozen at sea. However, even if all the possible economic benefits under Alternative 4 are realized, it is likely that paying observer costs would not be economically feasible for many vessels.

4.4.4.3 Effects on Recreational Fisheries

This alternative may have a negative economic effect on recreational fishers relative to Alternative 1. If the sector catch limit is exceeded, a closure of the recreational fishery will occur. However, under Alternative 1 this potential exists as demonstrated in frequent recreational closures and other restrictions that have occurred in recent years. Improvements in the recreational catch monitoring program may either reduce or increase the likelihood of restrictions. Under Alternative 4, NMFS' ability to detect excessive catches within the sector would be enhanced by an onboard Commercial Passenger Fishing Vessel (CPFV) observer program and expanded port/field sampling program.

A closure of the recreational fishery would result in fewer fishing experiences for private anglers and charter fishing patrons. The ability of the recreational sector to avoid a fishery closure by controlling catch of overfished species through an incentive program is likely to be limited, as there are many and diverse participants.

Dividing the recreational sector into geographical (e.g., state-based) subsectors could mitigate some of the negative effects of this alternative. For example, a resident of a state in which the recreational fishery has been closed would be allowed to fish in a state where the fishery remains open, provided he or she possesses a fishing license for that state.

4.4.4.4 Effects on Tribal Fisheries

Tribes are effectively a specified sector, with sablefish and whiting allocations that are functionally similar to species caps. The Tribes' allocations and anticipated catches of overfished species are not considered caps under the no action alternative. Alternative 4 would not change the amounts of any allocations.

If allocations were treated as caps under Alternative 4, they could have an adverse economic effect on Tribal fishers, especially if the Tribal Pacific whiting or sablefish fishery were closed as a result of early attainment of an overfished species cap. There has been some catch of canary rockfish, widow rockfish and dark-blotched rockfish in the whiting fishery. In most recent years, whiting provided the lion's share of harvest tonnage and a major portion of ex-vessel revenue. Consequently, the economic impacts of a fishery closure could be severe. However, given the experience of tribes in self-management with respect some aspects of the groundfish fisheries, their ability to avoid a fishery closure

through cooperative efforts to control the catch of overfished species is expected to be relatively high.

4.4.4.5 Effects on Buyers and Processors

The economic effects on buyers and processing companies are uncertain because of the uncertainty as to whether vessel owners within sectors can successfully manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing tactics, higher catches in the groundfish fisheries are expected. An increase in landings is likely to eliminate upward pressure on ex-vessel prices (unless harvesters can coordinate and through collective bargaining demand a higher price from processors), and greater throughput over constant fixed costs will result in lower average costs for processing facilities.

On the other hand, if a single disaster tow shut down an entire fishing sector, buyers and processors may experience significant shortages of fish. Current fish processing infrastructure could be disrupted if a race for fish developed under this alternative (although vessel caps would tend to prevent that.) Processors could be forced to increase capacity in order to process as much fish as possible before a major fishing sector shut down. Because the total volume of fish processed may not increase substantially under this alternative, any investments in additional processing capacity would be unlikely to result in net revenue gains for processors relative to the *status quo*.

4.4.4.6 Effects on Communities

To the extent that commercial harvesters were able to prosecute groundfish fisheries without being shut down, this alternative would not be expected to have a significant economic impact on communities. The groundfish fisheries would continue to benefit fishing communities as under the *status quo*. However, if sector closures did occur, there would likely be negative impacts in fishing communities, particularly if processing plants are also forced to close.

4.4.4.7 Effects on Consumers of Groundfish Products

If this alternative did not result in early closures of major harvesting sectors, it would be expected to have little impact on consumers relative to the *status quo*, as the price per unit, product availability, and product quality would be unlikely to change substantially. However, if major fishing sectors were shut down due to unexpected catches of overfished species, consumers could see a disruption in groundfish supplies. To the extent that supplies of fresh or live groundfish from West Coast fisheries were curtailed, a loss of consumer surplus could occur. A reduction in supplies of frozen West Coast groundfish would be likely to have a minimal effect on consumer surplus because this product form has many substitutes.

4.4.4.8 Effects on Fishing Vessel Safety

The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations may lead to reductions in injury and loss of life because of harvester's incentives to take fewer risks and use their best judgment in times of questionable weather conditions. However, if an intense race for fish developed, the increased competition among fishers would likely increase the risks they would be willing take to harvest fish. For example, vessels could be induced to fish in weather conditions that under the *status quo* would have kept prudent operators from fishing. The result would be a reduction in the safety of fishers while at sea.

On the other hand, early closure of a sector would reduce the amount of time those vessels were at sea, resulting in increased safety.

4.4.4.9 Effects on Management and Enforcement Costs

This alternative would be expected to notably increase management and enforcement costs for initial start up and over the long term. The sector allocations required by this alternative would take two to four years to develop, analyze and implement through the Council and NMFS management processes. However, certain other management costs would be reduced, particularly those associated with inseason catch projections.

As catch limits are allocated over an increasing number of sectors, NMFS would be required to manage increasingly small blocks of fish. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. Under Alternative 4, 60% commercial and recreational (CPFV) observer coverage, a logbook requirement for all commercial vessels and an expanded port/field sampling program to improve estimates of recreational catch would be used to monitor the harvest in each sector and ensure that catch caps are not exceeded. However, it would likely be necessary to have 100% coverage of trawl vessels to ensure the effectiveness of vessel and sector caps.

As discussed above in the analysis of the economic effects on commercial harvesters, the costs of expanded observer coverage would be borne mostly by industry, unless NMFS provided all observers at no cost to vessels. Funds for expansion of the observer program have not been identified. Nevertheless, the increase in the number of observers and its associated increase in the amount of data collected is expected to raise overall annual costs of the groundfish observer program. This budgetary increase may be attributed to additional staffing and augmented spending for data entry contracts. To monitor the catch of each vessel requires the use of increasingly sophisticated catch-monitoring tools, such as electronic reporting. Though computerized systems of electronic reporting and data management increase the quantity, quality, and timeliness of the information

available for fisheries management, they also increase the demands on management staff to effectively make use of a larger and more complex data system. These additional costs to the observer program have not been estimated.

An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection. The current program recently received additional funds so that its 2004 total budget is about $3.4 million ($2.2 million in federal dollars and $1.2 million from Oregon, Washington and California). However, it estimated that the program would require an additional $1 million to develop a comprehensive coastwide marine recreational fisheries data system (personal communication, Russell Porter, Field Programs Administrator, PSMFC, October 2003).

4.4.5 Social and Economic Impacts of Alternative 5 (Vessel catch quotas, discard caps)

This analysis examines the economic effects of the use of measures to reduce bycatch that are collectively referred to as dedicated access privilege systems, as the allocation of shares of the total allowable catch for species or species groups to individuals or groups conveys an exclusive right or privilege to catch a given quantity and species of fish (Sutinen et al., 1992).[7/] The primary focus of this analysis is the economic effects of implementing transferable restricted species quotas (RSQs) for overfished species and transferable individual fishing quotas (ITQs) for other groundfish species. However, this analysis will also briefly examine the potential economic effects of implementing group-based quota systems. The allocation of portions of the total allowable catch to fisheries cooperatives is one form of such a system (See Alternative 4 discussion of economic impacts on commercial harvesters). Another way to implement group-based quota systems is to modify an ITQ program to allow communities or other groups to enter into the market for quota shares. An example of such an approach is the measures the North Pacific Fishery Management Council approved in 2002 that would allow eligible fishing villages in the Gulf of Alaska to acquire ITQs for sablefish and halibut.

7/ The Magnuson-Stevens Act refers to an IFQ as an exclusive fishing privilege, rather than a right. In specific reference to authorizing IFQs or other limited access systems, the Act states that such an authorization, " (A) shall be considered a permit for the purposes of sections 307, 308 and 309; (B) may be revoked or limited at any time in accordance with this Act; (C) shall not confer any right of compensation to the holder of such individual fishing quota or other such limited access system authorization if it is revoked or limited; and (D) shall not create, or be construed to create, any right, title, or interest in or to any fish before the fish is harvested" (Sec. 303(d)(3)).

The economic and social impacts of the use of rights-based management in the West Coast groundfish fisheries will be determined largely by the initial allocation of quota shares. Persons or groups who are provided an allocation will gain an exclusive fishing privilege that others who do not receive an allocation will be denied. The effects of alternative allocations are discussed throughout this analysis and highlighted in a section describing wealth distribution issues with rights-based management (Section 4.4.5.9).

4.4.5.1 Effects on Fishers' Incentives to Reduce Bycatch

Reductions in the catch of unwanted fish under a rights-based system are expected to be achieved more easily than under the *status quo* because vessels will be more willing to accept the reductions in target species catch rates that they may incur by fishing at different times. Reduced catch rates will no longer equate with a smaller share of total catch since the vessel is assured of its right/privilege to harvest a fixed or proportional share of the total allowable catch for the entire year (as opposed to two-month periods under the no action alternative). In addition, fishers will be better able to time their harvests to coincide with periods when the *CATCH PER UNIT OF EFFORT* (*CPUE*) of certain target species is higher and bycatch is lower. For example, Dover sole and petrale sole form large spawning aggregations in the late winter and spring (personal communication, Steve Bodnar, Coos Bay Trawlers' Association, November 2003). Concentrating fishing effort during such periods can lower levels of bycatch as well as decrease fishing costs.

Fishers under this alternative may also have more flexibility in their choice of boat/gear configurations and fishing methods over the course of a fishing season. For example, gear endorsements may be modified to allow trawl vessels to use nontrawl gear or to convert their trawl endorsement to a new category of longline, pot or generic gear endorsement. This relaxation of regulations could allow fishers to modify their fishing operations and/or gear to better use their quotas and could facilitate the adoption of more selective fishing strategies.

A potential negative effect of a rights-based system is that fishers may have a heightened incentive to high grade: by throwing less valuable fish overboard, they can save their quota for more valuable fish. Under Alternative 5, however, vessels are charged for their entire catch and high grading does not save any of their quota . Unlike Alternative 1, the amount of fish discarded by each vessel would be recorded by an at-sea observer and counted against the vessel's limit. When a vessel reaches any catch limit, further fishing by that vessel for any groundfish would be prohibited until it acquired additional RSQ or ITQ shares. This measure provides strong economic incentives to reduce the catch of unwanted fish because it internalizes the external costs of discarding that fish in the private economic returns of individual fishers (i.e., the costs of discarding are borne directly by the fishers that discard). Consequently, it would be worthwhile for each fisher to take steps to improve the selectivity of their fishing gear and

techniques and avoid troublesome areas in the process. As a further economic incentive to fish more selectively, this alternative reserves a portion of some or all of the total allowable catch limits of overfished species for vessels with the best bycatch performance. Performance could be based on low incidental catch and/or bycatch rates or other factors.

4.4.5.2 Effects on Commercial Harvesters

Initial distribution of quota shares is a major policy issue that determines distribution of wealth and costs throughout the industry. Although there are many possible methods of determining initial allocation of shares, catch history is likely to be a major consideration.

Current vessel owners as a group are likely to benefit from a rights-based system that allocates freely transferable and leaseable quota shares to vessel owners on the basis of vessel catch histories. The overall increases in profitability for vessel owners will vary from fishery to fishery but could be substantial in many cases.

Not all vessel owners would benefit equally, and the relative benefits would depend on the formula that relates catch history to allocations. This formula is clearly of fundamental importance to individual operators in the industry, because it would affect both their wealth, through changes in the value of their fishing rights, and their income as affected by their catch (Geen et al., 1993). The fact that there is a history of trip limits under the *status quo* may facilitate the allocation of ITQs in the West Coast groundfish fisheries. The value of a limited entry permit currently reflects the potential earnings of a pre-determined catch amount. However, although no permit holder has the potential to land any more fish than any other permit holder given standard trip limits that apply, there is catch history variation due to vessel decisions, trip limits that vary by region, and trip limits that vary by gear (e.g., small footrope, large footrope). There can be a significant variation in the catch history within the fleet. In this situation, a relatively simple allocation formula, such as one that issues equal shares to all active permit holders, is unlikely to be considered fair and equitable. Now that the trawl buyback has occurred, however, an equal distribution of shares may not be fair and equitable. Some trawlers who were bought out may purchase new vessels and permits to again participate in the fishery. An allocation of equal shares would essentially doubly pay those vessel owners who were paid to the leave the fishery and who are now returning to the fishery by purchasing existing permits.

Another policy issue is who would be eligible to receive shares in the initial distribution. If a substantial portion of the initial quota shares is allocated to other groups (e.g., crew, processors, or community groups), vessel owners could potentially suffer an initial financial loss since they would have to purchase quota to conduct their historical level of fishing. Whether or not other gains in cost reduction or increased prices might offset the costs of acquiring quota can only be

determined after the structure of the rights-based system and allocation formula are determined, and even then it would be difficult to assess.

It is also important to note that the level and distribution of the benefits and costs of a rights-based system may vary by fishery and sector. The extent of the gains would depend on the degree to which the current management and bycatch mitigation programs have been leading harvesters and processors to sacrifice quality, produce lower value products, use more costly production processes, endure higher bycatch rates, or maintain excess capital and labor in order to increase production. Experience with rights-based systems in other fisheries suggests that improvements in the economic performance of the groundfish fisheries due to increased value and reduced costs may be substantial. However, because landing limits have been used in the West Coast groundfish fisheries to smooth out fishing and landings over the year, these fisheries already experience some of the typical gains from rights-based systems that result from elimination of the race for fish phenomenon, such as longer fishing seasons, mitigation of market gluts, and opportunities to improve product quality.

Nevertheless, a rights-based system would be expected to increase the value of production in the West Coast groundfish fisheries for a variety of reasons. Currently, an annual landed catch OY must be set below the ABC to account for the expected bycatch. Under Alternative 5, this reduction would not be necessary because all catch mortality would be measured through expanded observer coverage. Consequently, the total amount of fish available for harvest would increase.[8/] Further, increases in the value of production may be achieved as the harvest volume increases in fisheries that were previously constrained by landing limits. For example, some fishers may successfully modify gear and/or purchase enough canary rockfish RSQ to take advantage of yellowtail rockfish ITQ.

The costs of harvesting are also expected to fall for a variety of reasons. The ability of harvesters to catch their entire quota of certain species during periods of time when the species aggregate could substantially reduce fishing costs. In addition, individual vessels will have the opportunity to select the least-cost combination of fishing inputs (Crutchfield 1979; Scott 2000). At the industry level, costs will fall because production is expected to shift over time toward the most cost-effective harvesting operations. Consolidating harvesting operations and retiring or selling off vessels will reduce fixed costs for the industry. The cost savings will depend both on the constraints put on the transfer and consolidation of harvesting privileges and on the level of excess capacity prior to implementation of a rights-based system. It is also important to note that many of

8/ Assuming that fishery managers have been risk averse when estimating discards under the *status quo*, it is likely a system of accurate accounting of discards in the groundfish fisheries would allow fishery managers greater certainty in setting ABCs and OYs.

the efficiency gains from the adjustment of the fleet following the introduction of a rights-based system may be lost if departing fishers shift their effort toward non-groundfish fisheries, which themselves are overcapitalized. One additional potential benefit to vessel owners from a rights-based system is that private banks and government agencies may come to treat quota shares as having financial value that may allow them to serve as collateral for loans, thereby improving the ability of quota holders to obtain financing for capital investments.

These economic benefits must be weighed against the additional operating costs that vessel owners will incur from the expanded observer coverage required under a rights-based system (See Alternative 4 discussion of effects of increased observer coverage on commercial harvesters). The increase in net revenues that commercial harvesters are expected to experience under a rights-based system may render them better able to sustain the costs of an observer requirement. However, even if the economic benefits of a rights-based system are fully realized, it is likely that paying observer costs would not be economically feasible for many vessels because they would not be able to generate enough cash flow to cover those additional costs. As noted in the effects analysis for Alternative 4, the installation of video cameras on board vessels to document vessel activities at sea has the potential to substantially reduce the costs of monitoring catch and discards. However, further testing of the effectiveness of this type of electronic monitoring technology is needed to determine whether and in which cases is may be adopted as a lower cost alternative to at-sea observers.

Implementing a rights-based system presents special difficulties for fisheries such as the West Coast groundfish fisheries in which multiple species are often caught together. Matching quota to actual harvests is problematic because of uncontrollable factors, such as ocean temperature and other environmental factors that can lead to variations in the mix of species caught from place to place and over different periods. Moreover, disaster tows can occur in which the dominant species is other than the target species. In theory, a rights-based system can address the problem through quota trading, either by purchase or lease of additional quota (Dewees and Ueber, 1990). In some cases, however, the fisher may be unable to buy or lease more quota. This might be because no other harvester has quota to sell or the trading price for quota is greater than the fisher is able to pay. (The prices of RSQ shares may become especially high as the fishing season progresses due to the constraints they may impose on harvests of target species.)

Pascoe (1997) describes a number of contingency systems that have been used to address these problems in multi-species fisheries with varying success. A permissible quota over-run is used as a bycatch management option in New Zealand and British Columbia (Larkin et al., 2003; Wheeler et al. 1992 cited in Pascoe, 1997). A permissible quota over-run policy allows fishermen to exceed their quota holding in a given year in return for a reduction in their quota the following year. In New Zealand, permissible quota over-runs are limited to 10%

of the original quota for all species. Another system used in New Zealand allows fishers to land species for which they do not hold quota and record it against the quota held by another fisher. This is effectively an informal quota leasing arrangement, because the catchers of the fish usually pay the holders of the quota for the use of their quota (Baulch and Pascoe, 1992 cited in Pascoe, 1997).

The need for such contingency systems can also indicate an inadequacy in the formal quota trading system. For example, if all quota purchases or leases are required to be recorded by NMFS, the transaction costs might be high due to bureaucratic inefficiencies. An alternative would be to allocate quota to a cooperative and allow its members to internally distribute the quota shares and develop a system for leasing and selling shares. When the quota trading system is decided by fishers themselves, transaction costs can be substantially lower.

In general, cooperatives can be expected to provide the same net benefits to vessel owners as an ITQ program. However, the rules governing cooperatives will be important in determining the distribution of benefits between harvesters and processors. For example, it has been argued by some fishing vessel owners in the Alaska pollock fishery that the rules for inshore cooperatives established under the American Fisheries Act have actually hurt independent vessel owners financially. Rules for these cooperatives restrict the ability of vessels to transfer between cooperatives and require members of a cooperative as a group to deliver 90% of their catch to one processing firm associated with that cooperative. Compared with cooperative rules that would allow for free movement of vessels between cooperatives, the present inshore cooperatives shift the balance of power in price negotiations toward the processors. Halvorsen, et al. (2000) reported that variations on the current rules that would allow smaller groups of fishing vessels to form cooperatives and easier movement between plants would tend to shift the balance of bargaining power to vessel owners. This shift, in turn, would increase their share of any net benefits resulting from increased efficiency and product value that might occur as a result of rights-based management. In short, the overall gains to vessel owners that might be expected in terms of increasing the value of catch and decreasing harvesting costs are likely to be smaller with cooperatives than with ITQs if the ability of vessel owners to form and transfer between cooperatives and to freely choose their point of delivery is limited.

The impacts of community quota programs on vessel owners is even less clear. Some vessel owners might gain if communities, in turn, grant them catch rights that enable them to slow down and choose fishing times; however, there is the potential that others might be harmed financially if their current ability to harvest resources is curtailed and they need to buy or lease catch rights from communities. Even if a community grants catch rights at no charge, the profitability of the vessel owners could still be undermined if their freedom to choose which buyers they sell their fish to is limited by the community.

4.4.5.3 Effects on Recreational Fisheries

An IFQ program would not apply to the recreational fishery, and an IFQ would not necessarily result in any change in the proportion of the total groundfish catch taken by or allocated to the recreational sector. However, in order to protect the IQ shares for the commercial fleet, Alternative 5 would require establishment of allocations for the recreational fishery similar to or the same as those in Alternative 4. In this respect, Alternative 5 may have a negative economic effect on recreational fishers relative to the *status quo*. A closure of the recreational fishery due to it reaching its allocation would result in fewer fishing experiences for private anglers and charter fishing patrons. Dividing the recreational sector into geographic (e.g., state-based) subsectors could mitigate some of the negative effects.

If the ITQ program were expanded to include the recreational sector, or if recreational fishers, fishing groups or charter companies were allowed to obtain quota shares, the economic effects of Alternative 5 relative to the *status quo* would be different. The following analysis of potential economic effects on the recreational and charter fishing sectors draws from Anderson's (1992) discussion of the possibility of creating ITQs for both recreational and commercial fishers.

Anderson notes that an advantage of fishery management with ITQs is that it is possible to simultaneously create tradable quota shares for various sectors, including the recreational, charter, and commercial fishing sectors. There are many options that could be developed. With full trading of ITQ shares permitted between sectors, users could determine the most desirable allocation of the stocks, based on their willingness to pay for shares of the resource. For example, recreational harvesters could increase their share of tota1 catch by purchasing ITQ shares from commercial harvesters or commercial harvesters could buy recreational ITQ shares.

An obstacle to establishing the initial allocation of quota shares for the recreational sector is that individual recreational landings are typically difficult to document. Anderson suggests that recreational ITQ shares could be given away on an equal basis through a lottery. Entities such as fishing clubs or state/local government agencies could also receive shares if it is decided these groups were proper representatives of recreational fishers. Part of the initial recreation allocation could also be assigned to non-ITQ bag limit fishing.

4.4.5.4 Effects on Tribal Fisheries

Alternative 5 would not change any Tribal allocations. If Tribal fishers are included in the IQ program, or allowed to purchase IQ from non-tribal fishers, they would receive similar benefits. Alternative 5 is expected to have a minimal economic effect on tribal groups. The coastal Treaty Tribes have negotiated allocations of sablefish and Pacific whiting, and there are several other groundfish species taken in Tribal fisheries for which formal allocations have not been established. Allocations of these species could be negotiated in a similar manner.

4.4.5.5 Effects on Buyers and Processors

Groundfish buyers and processors are expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system as discussed in the effects on commercial harvesters. The overall level of benefits and the distribution of benefits across processors may depend largely on the formula for allocating quota shares. Owners of processing plants (other than catcher-processors) have not been granted allocations of shares in prior ITQ programs in the United States, although such allocations may be granted under the Alaska crab fisheries rationalization program. Arguments have been made (e.g., Matulich and Server, 1999; Matulich and Clark, 2003) that harvester-only ITQ programs may lead to expropriation of quasi-rents from processors.[9/] This could result if excess processing capacity exists and there are no alternative uses for processing equipment. It is also possible that plant owners would share in the overall economic gains that could be made through fishery rationalization. The degree to which this might occur will likely depend on the level of excess capacity and the degree to which plant owners are engaged in competition with each other to gain market share. If processors are somehow guaranteed shares, they would naturally be more likely to benefit or less likely to suffer harm from implementation of a harvester-only ITQ program.

The discussion of the effects of Alternative 1 on buyers and processors indicates that processors have been able to maintain a steady flow of fish into their plants and, therefore, have been able resist the competitive pressure to outbid competitors for raw materials even in the face of declining harvests. Furthermore, even though each harvester is effectively guaranteed his or her trip limit in each two-month period under the *status quo*, fishers as a group have not been able to acquire a significant amount of bargaining power in exvessel markets. These factors suggest that the conditions in which harvesters can usurp processor quasi-rents, as described by Matulich and Server (1999), may not be present in the West Coast groundfish fisheries. While the absence of such conditions should not necessarily preclude the allocation of shares to processors, it is important to recognize that a significant loss of processor bargaining power does not appear to be likely under a harvester-only ITQ program.

As noted above, the structure of cooperatives in which harvesting agreements are negotiated can also affect the benefits that accrue to owners of processors from rights-based management. In general, processors can be expected to benefit more from a cooperative structure in which the ability of vessel owners to form and transfer between cooperatives, to sell or lease catch rights, and to freely choose

9/ Quasi-rent is the difference between the selling price and the variable costs of a product. Expropriation here means some potential benefits would go to harvesters instead of processors.

their point of delivery is limited, though the absolute distribution of profits created by the move to cooperatives in any particular fishery is not clear.

Community fishery quotas might also provide protection to processors in small communities if the communities restrict the landing locations of their quotas. However, if the program worked similarly to the current western Alaska CDQ program, communities could lease out quota to operations that processed elsewhere and local processors might be preempted.

In summary, rights-based systems may have the potential to reduce the competitiveness of markets and shift the balance of bargaining power between harvesters and processors. Care must be taken to minimize threats to competitive markets and to avoid, or at least be aware of, shifts in bargaining power that may result in income transfers between processors and harvesters. Exvessel markets for fish may already be quite thin in the West Coast groundfish fisheries, with few buyers in a number of locations. Consolidation of harvest and processing sectors will make these markets thinner yet. The number of buyers competing for fish may be reduced to a few or a sole buyer in some cases, if restrictions were to be placed on where fish can be delivered. The possible result would be a shift in income from harvesters to processors.

On the other hand, without restrictions on where or to what plants fish can be delivered, income transfers may move in the other direction. The temporal spreading of fishing may cause processors to bid up prices in an attempt to lower average costs by increasing the amount and duration of their processing. As Matulich and Server (1999) point out, there is the potential under certain conditions that the quasi-rents of processors may be expropriated by harvesters in this process. The possibility also exists that harvesters with sufficient shares of the total allowable catch might have enough market power to make monopoly profits by reducing output below the catch limit. However, the danger of monopolistic practices is low, because West Coast groundfish are sold in regional, national, and international markets where they must compete with similar species produced in other regions of the world as well as with other seafood products.

4.4.5.6 Effects on Communities

Prior rights-based systems implemented in U.S. fisheries have not allocated initial quota shares to vessel crews or other employees of fishing or processing companies. If any of these individuals were allocated shares under a rights-based system, they would be expected to make financial gains similar to those made by vessel owners receiving shares.

If crew members are not allocated shares, it is uncertain whether they could expect their long-term earnings to rise or fall with a rights-based system. In the Alaska halibut and sablefish ITQ fisheries, crew members have sometimes been

expected to contribute toward the cost of quota shares used, but increases in the value of production have led to higher crew incomes. Whether crew members and other seafood industry employees are likely to share in the net gains in profitability that result from an ITQ program or other rights-based system implemented in the West Coast groundfish fisheries will depend on the supply and demand for labor, which is likely to vary by fishery and area.

One likely impact in any type of rights-based system is a decrease in the number of crew members and processing workers employed. This is a natural consequence of the consolidation of fishing and processing activities to fewer vessels and plants. As a form of compensation for the potential loss of employment opportunities in the Alaska sablefish and halibut fisheries, the North Pacific Fishery Management Council made the provision that the only persons who could purchase IFQ shares that were not initial recipients had to be bona fide crew members with at least 150 days of fishing experience. With this provision, crew members who might otherwise lose their jobs can establish themselves in the fishery, and because the owner of the quota shares is required to be onboard when the IFQs are fished, these crew members can guarantee themselves a position (Hartley and Fina 2001b). Moreover, crew members who purchase quota shares increase their value as crew, because their quota shares add to the overall harvest limit of the vessel on which they work (Ginter and Muse, 2002).[10/]

On the other hand, rights-based systems could lead to the preemption or reduction of fishing, processing, and shoreside support activities in some traditional fishing communities unless restrictions are implemented to inhibit or prohibit a geographic redistribution of landings. This would be a natural consequence of consolidation in the industry as excess capital is scrapped or allowed to degenerate without replacement and production is shifted to more efficient operations. Even if reductions in harvesting and processing capacity were uniform across communities, one would expect a decrease in economic activities

10/ Both crew members and vessel owners have been assisted in purchasing sablefish and halibut IFQ shares by the North Pacific IFQ loan program, a financing mechanism authorized by the MSA in 1996. The Magnuson-Stevens Act specifies that 25% of the fees collected by NMFS to manage the sablefish and halibut IFQ program must be deposited in a U.S. Treasury Department account and made available for appropriation to support the loan program. To date, however, the program has largely been supported by a Congressional appropriation. The Magnuson-Stevens Act specifies that the loan program is to provide aid in financing: 1) the purchase of individual fishing quotas in that fishery by fishers who fish from small vessels; and 2) first-time purchase of individual fishing quotas in that fishery by entry level fishers. Currently, the program has approximately $5 million available for financing quota share purchases. In FY 2002, 39 loans were issued, mostly to vessel owners and crew members who fish from small (< 60 ft. LOA) vessels.

in fishery support sectors due to reductions in harvesting and processing capital. ITQ programs and cooperative programs can be designed to reduce or prevent this. Doing so could entail some sacrifice in overall efficiency gains, but this must be weighed against the social benefits of preserving traditional fishing communities.

Granting quota shares to community groups would be an alternative and more transparent way to assist traditional fishing communities in remaining involved in the fisheries or in providing them financial resources to develop new industries. Moreover, such group-based systems may lead to a more optimal concentration and reallocation of quota shares in the sense that broader social considerations could be internalized (Gréboval and Munro, 1999).

In conclusion, constraints on the restrictions on the use, transfer and accumulation of ITQs may serve to protect communities' or fishery sectors' opportunities and benefits. However, the social benefits of these measures should be weighed against the efficiency losses. The greatest increase in profits for the overall industry is likely to come from a system with a minimum of constraints on transferability and use of quota shares. For the industry as a whole, increases in profitability can be achieved by shifting harvesting and processing from less efficient operations to more efficient ones. Gains in economic efficiency may be made by concentrating production in fewer operations, especially if there are firms with excess harvesting or processing capacity—as continues to be the case in most sectors of the West Coast groundfish fisheries. Furthermore, it is possible, but by no means certain, that there are economies of scale that would favor larger firms and lead to greater concentration of the industry. At the same time, however, one must recognize that it is this potential for increasing profits by shifting and concentrating harvest and processing operations that poses the threat of preemption of sectors and communities.

4.4.5.7 Effects on Consumers of Groundfish Products

Because landing limits in the groundfish fisheries already maintain a year-round season, consumers are already experiencing some of the typical gains from rights-based systems, such as the availability of fresh fish in markets throughout the year. In addition, consumers are expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system.

There is some chance that consumers could be negatively affected, if a rights-based system leads to a decrease in the overall competitiveness of markets for certain groundfish products (e.g., live fish). The likelihood of this occurring depends both on the level of consolidation that might occur and the elasticity of demand for particular products. A decrease in competitiveness could result in higher product prices without accompanying increases in quality, which, in turn, would reduce consumer surplus.

4.4.5.8 Effects on Fishing Vessel Safety

Alternative 5 would be predicted to improve the safety of groundfish fishing operations compared to the *status quo*. As with a number of effects previously discussed, the gains in fishing vessel safety that are typically attributed to rights-based systems are partially realized under the *status quo*. These fishing safety benefits include the opportunity to fish at a more leisurely pace and avoid fishing in dangerous weather or locations, within the constraints of two-month fishing periods. However, under Alternative 5 the constraints of two-month periods would be eliminated, allowing vessels to operate in the best possible conditions. The result would be further reductions in injury and loss of life because of harvester's incentives to take fewer risks and use their best judgment in times of uncertain weather conditions. In addition, if higher net earnings are realized under a rights-based system, individual harvesters will have additional funds for vessel maintenance and safety equipment. At the same time, it is important to recognize that rights-based management does not guarantee that fishers will adopt safe fishing practices. Under an ITQ program, for example, market opportunities may still encourage fishers to fish at times or in places that are unsafe. For example, some fishers may still choose to fish in bad weather if the best price for catch is offered during and immediately after storm periods.

4.4.5.9 Distribution Issues with Rights-Based Management

As noted previously, the economic and social impacts of expanded use of rights-based management in the West Coast groundfish fisheries would be determined largely by the initial allocation of quota shares. Whether shares of the total allowable catch are allocated to individuals, cooperatives, or communities, the basis for determining the allocation would undoubtedly be controversial. The allocation mechanisms are likely to vary significantly, depending on the type of rights-based system or systems implemented. If the Council and NMFS decide to move towards a rights-based management program, consideration of specific alternatives and further analysis of impacts will be required.

During the development of a rights-based system, a wide variety of allocation mechanisms and formulas should be considered. Although past ITQ programs in the United States have allocated quota shares to vessel owners based on catch histories, other options should also be examined, such as those that attempt to incorporate objectives that maximize net benefits to society. For example, the criteria for initial allocation of quota shares could include a vessel's acceptance of conservation goals (National Research Council, 1999). Further, retention of shares could be contingent on the vessel's ability to pass a regular performance review.

When allocating quota shares, it is important to bear in mind that granting shares to individuals free of charge is likely to result in those individuals receiving substantial windfall gains. These windfall gains may be construed as a transfer of

wealth from the public to certain individuals, since exclusive withdrawal rights to publicly owned resources are being gifted. Whether and to whom this wealth should be gifted is an important question that should be carefully considered.

It has been argued that vessel owners have invested their labor and risked their capital (and often their lives) to develop fisheries, and, in return, they should be given preferential access to those resources. However, vessel owners as a group are only one element of a diverse collection of stakeholders who might be viewed as possessing a right to benefit from resources harvested in federally-managed fisheries (or from other resources directly or indirectly affected by those fisheries). Possible other stakeholders include, but are not limited to, skippers who are not vessel owners, vessel crew, processors, fisheries scientists, persons with interests in marine conservation, and individuals in communities that support fishing and processing operations,. Clearly, there are equity reasons for considering whether and how these other stakeholders might be included in initial allocations of ITQ shares. Furthermore, the Magnuson-Stevens Act requires fishery managers to consider the allocation of a portion of the annual harvest in a fishery for entry level fishers, small vessel owners, and crew members who do not hold or qualify for individual fishing quotas.

While recognizing that the Magnuson-Stevens Act may currently restrict such actions,[11/] fishery managers might also consider the future prospect of selling or auctioning some or all of the ITQ shares to allow the public to capture all or a share of the windfall gains created by the ITQ system (Macinko and Bromley, 2002). A variety of tax mechanisms could also be used to capture a portion of the net economic returns that fish harvesting might generate and place them in the public coffer. The mechanism for collecting these profits should be implemented at the beginning of the ITQ program, as the windfall gains accrue to the initial holders of quota (Sutinen et al., 1992)

If cooperatives are expanded to other West Coast groundfish fisheries, the cooperatives themselves would likely be responsible for allocating quota shares among their individual members. However, an equitable method of allocating among cooperatives is still required. If quota shares are granted to communities, allocations might be based on the historic landings made in those communities and/or the pooled catch histories of the communities' residents. A variety of other formulas might be developed to meet particular social and economic objectives. Under the western Alaska Community Development Quota (CDQ) program, allocations to CDQ groups are not fixed in order to allow flexibility in directing benefits and achieving community development goals. In such an

11/ Section 304(d) of the Magnuson-Stevens Act places strict limitations on fees that can be levied on the fishing industry. These limitations effectively preclude auctions or other means of collecting some of the rents that may be created with ITQs (Anderson, 1992).

arrangement, it is of paramount importance that the process for allocating community quotas be stable and transparent (National Research Council, 1999).

Whether quota shares are allocated to individuals, cooperatives or communities, it may be prudent to put in place mechanisms that will allow the nature of the fishing privileges to be altered. A stable set of privileges and responsibilities with a long time horizon is important to promote the efficiency and stability of the fishery, but it is also important to maintain administrative flexibility for unforeseen eventualities that may oblige changes in the distribution of quota shares. One such mechanism discussed by the National Research Council (1999) is referred to as the Australian drop-through system. In this system, initial entitlements are defined and fixed for a long but finite period: 30 years in certain Australia fisheries. Periodically, perhaps every ten years, a comprehensive review of these entitlements takes place and changes can be made to the set of rights and obligations. Shareholders can switch to this new set of entitlements (whatever is currently on offer) any time before the term of their old entitlements expire, at which time they would automatically exchange entitlements for the current set on offer. Switching to the new entitlement package locks in the right to guard those entitlements for the remaining life of that entitlement. Other systems of balancing stability with flexibility are possible. The most important element is to strike the proper balance to protect the health and prosperity of the fishery and the authority of regulators to make appropriate management decisions in the best interest of the public.

4.4.5.10 Effects on Management and Enforcement Costs

This alternative would be expected to notably increase management and enforcement costs for initial start up and over the long term. The sector allocations required by this alternative would take two to four years to develop, analyze and implement through the Council and NMFS management processes. However, certain other management costs would be reduced, particularly those associated with inseason catch projections.

Experience with the ITQ programs in fisheries around the world indicates that such programs typically result in substantial increases in the costs of monitoring, enforcement, and administration. If ITQs and/or other rights-based systems are implemented in the West Coast groundfish fisheries, NMFS will be required to manage increasingly small blocks of fish. It will be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches of a large number of individual vessels. Under Alternative 5, 100% observer coverage is used to monitor the harvest of each participant and ensure that the harvest does not surpass the individual's current quota level. Even if the costs of this expanded observer coverage are largely borne by industry, the NMFS groundfish observer program can expect to see an increase in overall annual costs as a result of the increase in the number of observers and its associated increase in the amount of data collected. This budgetary increase can be attributed to additional

staffing and augmented spending for data entry contracts. To monitor the catch of each vessel requires the use of increasingly sophisticated catch-monitoring tools, such as electronic reporting. With transferability, it will also be necessary to keep track of the current amount of quota owned or leased by each participant. Though computerized systems of electronic reporting and data management increase the quantity, quality, and timeliness of the information available for fisheries management, they also increase the demands on management staff to effectively make use of a larger and more complex data system. These additional costs to the monitoring program are likely to be substantial.

Lastly, a rights-based management system requires additional agency resources to develop the process through which fishing rights are assigned and to adjudicate appeals about the assignment of fishing rights to individuals or groups.

The Magnuson-Stevens Act provides for cost recovery measures that can impose a fee on quota holders of up to 3% of the ex-vessel value of IFQ landings. Total fee collections cannot exceed the annual cost of management and enforcement. Such measures were implemented for the Alaska sablefish and halibut IFQ program in 2001. Seventy-five percent of fee payments are deposited in the Limited Access System Administrative Fund and made available to NOAA Fisheries to offset costs of management and enforcement of the halibut and sablefish IFQ program.

4.4.6 Social and Economic Impacts of Alternative 6 (Marine reserves, individual caps and full retention)

This alternative includes a wide array of measures to reduce bycatch, including a 100% groundfish retention requirement, marine protected areas and transferable RSQs for overfished species, and ITQs for other groundfish species. The mixture of measures complicates an analysis of the economic impacts of the alternative because the economic effects of some measures may be offsetting. For example, the decrease in costs that commercial harvesters are expected to experience under an ITQ program may render them better able to sustain possible reductions in harvests and revenues caused by the establishment of marine reserves (large portions of which are assumed to be set aside as no-take areas). However, in most cases there is insufficient information to determine the net economic effect of multiple management measures on various components of the human environment.

4.4.6.1 Effects on Fishers' Incentives to Reduce Bycatch

This alternative represents both a traditional command-and- control approach to reducing bycatch, and a market-based approach that removes the economic incentives that lead to bycatch. Marine reserves would prohibit fishers from fishing in certain areas in order to reduce the probability that fish will be caught and discarded, while the 100% retention requirement would be the primary means

of reducing bycatch outside of marine reserves. Forbidding discarding produces a strong incentive to develop and apply more selective gear because the costs of sorting, storing, transporting and disposing of fish that cannot be sold may be substantial. In addition, Alternative 6 is similar to Alternative 5 in that individual commercial groundfish vessels would be assigned transferable RSQs for overfished species and ITQs for other groundfish species. As described in the effects analysis for Alternative 5, RSQs and ITQs provide an economic incentive to avoid catching overfished species and unwanted fish, if an effective monitoring and enforcement program is in place.

4.4.6.2 Effects on Commercial Harvesters

Under this alternative, there are both measures that may significantly increase and decrease fishing costs. The level of these increases and decreases and extent to which they may be offsetting is uncertain. The 100% groundfish retention requirement as well as the establishment of marine reserves are likely to increase average costs, whereas the establishment of ITQs for groundfish species is likely to reduce costs and increase revenues.

The establishment of ITQs for groundfish species is expected to reduce the costs of harvesting (See Alternative 5 discussion of economic impacts on commercial harvesters). Individual vessels will have the opportunity to select the least-cost combination of fishing inputs. At the industry level, costs will fall because production is expected to shift over time toward the most cost-effective harvesting operations. Fixed costs will be reduced by consolidating harvesting operations and retiring or selling off vessels. These cost savings will depend both on the constraints put on the transfer and consolidation of harvesting rights and on the level of excess capacity prior to implementation of a rights-based system. Cost savings will also depend on the ability of harvesters to catch and sell a greater percentage of a particular species during periods when the species aggregate.

As discussed in Alternative 5, a rights-based system is also expected to increase exvessel revenues. Currently, a landed catch OY may be set below the ABC to account for the expected bycatch. Under Alternative 6, this reduction would not be necessary because all catch mortality would be counted against each vessels catch/mortality quotas and measured through expanded observer coverage. Consequently, the total amount of fish available for harvest would increase.[12/]

12/ Assuming that fishery managers have been risk averse when estimating discards under the *status quo*, it is likely a system of accurate accounting of discards in the groundfish fisheries would allow fishery managers greater certainty in setting ABCs and OYs.

These economic benefits must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage required under a rights-based system (See Alternative 4 discussion of effects of increased observer coverage on commercial harvesters). The increase in net revenues that commercial harvesters would be expected to experience under a rights-based system may render them better able to sustain the costs of an observer requirement. However, even if the economic benefits of a rights-based system were fully realized, it is likely that paying observer costs would not be economically feasible for many vessels due to their inability to generate sufficient cash flow to cover the added expenses. As noted in the effects analysis for Alternative 4, the installation of video cameras on board vessels to document activities at sea has the potential to substantially reduce the costs of monitoring catch and discards. While further testing of the effectiveness of video monitoring is needed, it should be noted that the 100% groundfish retention requirement may enhance the practicality of this type of electronic monitoring technology (Appendix C).

The 100% groundfish retention requirement could also have a positive or negative effect on the commercial harvesting sector depending on how much the fish formerly discarded would decrease the vessel hold space available for more valuable product and the revenue earned from product derived from the additional fish retained. Revenue per trip may decrease if a large amount of hold space is taken up by lower-valued fish. Vessels may offset some lost revenues by taking additional fishing trips. However, the number of trips vessels can make would be strictly limited by the catch allowance for overfished groundfish species. When the catch allowance is reached, a vessel must stop fishing unless additional RSQ shares are obtained. It is also possible that markets could be expanded for some groundfish species that currently fetch lesser prices. However, the prospect of market development is uncertain.

The problem of damage to target species by mixing wanted and unwanted groundfish in the hold may be a problem for some vessels. For example, dogfish sharks have high levels of urea (or more generally, non-protein nitrogen - NPN - compounds) in their flesh and when the shark dies bacteria rapidly convert this to ammonia, contributing to spoilage. This problem may be avoided if sharks are segregated in a separate hold. However, most vessels are unlikely to be able to dedicate an entire hold to the dogfish sharks that are taken. The problem of contamination of target catch could also be avoided by on-board processing of the sharks in order to remove as much of the NPN compounds as possible. However, the costs involved in processing and preserving dogfish shark meat currently outweigh the revenue that might be garnered from doing so. For some species there is currently no established market. If vessels cannot sell the additional fish retained, they may face delivery costs for shipment to a disposal site. Smaller trawl vessels may be disproportionately affected by the groundfish retention requirement, because they are more likely constrained by hold space during a fishing trip.

The possible spatial displacement of fishing effort resulting from the establishment of marine reserves may also have a negative economic impact on many fishing operations. Displaced fishers would have the option of relocating their fishing activities to groundfish grounds that remain open. However, open areas may be less productive, and competition for remaining good fishing locations would increase. Consequently, catch rates will likely fall, translating into less harvesting revenue for any given effort level. In addition, the area closures may force some fishers to travel further than previously, increasing operating costs.

The marine reserves established under this alternative could also cause product quality to decline. It is reasonable to assume that, subject to regulatory constraints, harvesters target certain species in areas that maximize value either by increasing the quality of the fish or by decreasing the harvesting cost or both. Consequently, a measure that prohibits vessels from using historical fishing grounds may result in a decline in product quality (e.g., fish may be smaller or a less uniform size). In addition, the quality of some groundfish species may deteriorate as the time from harvest to processing lengthens. To the extent that the establishment of marine reserves results in vessels traveling farther distances from processors, and thereby lengthening the time between harvest and processing, the quality of product would be adversely affected.

On the other hand, marine reserves have the potential to enhance exploited populations and benefit fisheries by: 1) dispensing larvae that replenish fishing grounds removed from marine reserve source populations; 2) exporting biomass to adjacent fishing grounds in the form of emigrating juveniles and adults; and 3) protecting portions of exploited stocks from genetic changes, altered sex ratios, and other disruptions caused by selective fishing mortality (Murray et al., 1999). These benefits could potentially mitigate, in part, deleterious effects of overfishing and restore, stabilize, or enhance fishery yields for some stocks (Dugan and Davis, 1993). In addition to higher catches, possible gains to the groundfish fisheries from marine reserves include reduced variability of catch and reduced probability of fishery closures due to overfishing (Thomson, 1998). However, it should be noted that even if marine reserves have the potential to have a positive effect on fish populations and fishery productivity, it may take several years after the area closures are established for this effect to be realized. For example, considering the longevity and erratic recruitment of many rockfish, it might be decades before marine reserve benefits to rockfish stocks and outside fisheries are demonstrated (Yoklavich, 1998 cited in Murray et al., 1999). Given this time lag, it is improbable that the potential economic benefits of marine reserves would accrue to the current generation of groundfish fishers. Even if the lag is considerably shorter, it is likely to be perceived as too long for most fishers whose social and economic well-being is contingent on shorter schedules (Murray, et al., 1999).

Reductions in fishery landings associated with the establishment of marine reserves and the resulting social and economic adjustments required by fishers may be partially mitigated by phasing in marine reserves to distribute the loss of fishing grounds and related catches throughout several years. During this period, the benefits obtained from marine reserves may begin to offset losses due to displacement of fishing activities (Sladek, et al., 1997 cited in Murray et al., 1999).

4.4.6.3 Effects on Recreational Fisheries

An IFQ program would not apply to the recreational fishery, and an IFQ would not necessarily result in any change in the proportion of the total groundfish catch taken by or allocated to the recreational sector. However, in order to protect the IQ shares for the commercial fleet, Alternative 6 would require establishment of hard caps (catch limits) for the recreational fishery similar to or the same as those in Alternatives 4 and 5. In this respect, Alternative 6 may have a negative economic effect on recreational fishers relative to the status quo. A closure of the recreational fishery due to reaching its allocation would result in fewer fishing experiences for private anglers and charter fishing patrons. Dividing the recreational sector into geographic (e.g., state-based) subsectors could mitigate some of the negative effects.

Alternative 6 also includes the measure of establishing no-take reserves, which will create additional impacts. As with commercial fishers, participants in recreational fisheries could potentially benefit over the long term from increases in local catch rates and fish size due to spillage of adults out of the marine reserves (Parrish et al., 2001).

On the other hand, if the establishment of marine reserves results in a geographic redistribution of the commercial and recreational fleets, the concentration of fishing effort in the areas that remain open may lead to localized depletion of stocks and a decline in catch per unit effort and individual harvests. Lower individual catches would mean a reduction in the quality of the fishing experience to a number of recreational fishers and charter fishing patrons. The value of the fishing experience would be further reduced if marine reserves increase the distance that recreational fishers must travel to reach productive fishing grounds.

While not completely immobile with respect to a port of operation, charter boat operations are location dependent both in terms of their reliance on location-specific marketing channels to bring them customers and the effects of distance to fishing grounds on profit (Parrish et al., 2001). Increased distance to fishing grounds may affect both the cost and revenue side of their profit function (increased distance and travel time increases the fuel and labor opportunity costs and at the same time would likely decrease willingness of customers to take a trip). Charter vessels that work as independents rely on charter offices to book their clients, and have somewhat more locational flexibility than those vessels that

serve as their own booking agents. Charter booking offices, on the other hand, are more closely tied to the fishing opportunities available in the port that they serve.

Recreational fishers would face the same situation as described for charter vessels, except that recreational fishers may be more mobile in their choice of fishing ports (Parrish et al., 2001). The likelihood that fishers would change fishing ports depends on the degree to which fishing is the primary purpose of a trip and the distance to alternative ports.

4.4.6.4 Effects on Tribal Fisheries

The individual vessel catch limit provisions of Alternative 6 would not change any Tribal allocations. If Tribal fishers were included in the ITQ program, or allowed to purchase ITQ from non-tribal fishers, they would receive similar benefits. In this respect, Alternative 6 is expected to have a minimal economic effect on tribal groups. The coastal Treaty Tribes have negotiated allocations of sablefish and Pacific whiting, and there are several other groundfish species taken in Tribal fisheries for which formal allocations have not been established. Allocations of these species could be negotiated in a similar manner.

Any marine reserves that overlap usual and accustomed (U&A) fishing areas would have to be approved by the Tribes or would not apply to Tribal fishers. Fishing restrictions in marine reserves could conflict with federally recognized treaty rights of tribes to fish in their U&A fishing areas (Parrish et al., 2001). Under these circumstances, it may be possible that NMFS and tribal authorities could negotiate a co-management arrangement whereby tribes were granted preferential access to marine reserves for selected purposes, and certain responsibilities related to marine reserve management were delegated to the tribes.

4.4.6.5 Effects on Buyers and Processors

As with commercial harvesters, the net economic effect of Alternative 6 on buyers and processors is uncertain. In general, buyers and processors are expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system. The 100% retention requirement could also result in a large increase in landings. However, it is uncertain how much of the additional fish retained would be marketable. While some fish are currently discarded because trip limits are exceeded, other fish are discarded for economic reasons. It is likely that over time buyers and processors will be able to develop new markets and expand existing markets to more fully absorb the increased supply of groundfish that would be associated with 100% retention in the groundfish fisheries. At a minimum, some processors already have the capability of processing low-grade fish as fish meal. There may be concerns that increased retention will overwhelm existing infrastructure and supplies of potable

water (Radtke and Davis, 1998). However, it is expected that over the long term processors will be able to carry out the market development, structural changes, and operational adjustments required to accommodate the additional groundfish retained. To facilitate this transition, a multi-year phased-in program for retention of groundfish could be adopted. For example, the program could start at 25% retention the first year and increase in fixed increments over subsequent years until 100% retention is achieved.

Because of their lack of mobility, we would expect the possible negative impacts of marine reserves on buyers and processors to be greater than the impacts on fishers as a group. However, the effects of Marine reserves on specific buyers and processing companies will depend in part on changes in local supply and how processors have adapted to current supply situations (Parrish et al., 2001). Processors that have continued to rely on local supply to maintain operations at a particular plant will be most affected by any change in local supply. Processors that have adapted to current fishery conditions by centralization of processing and distribution activities may be somewhat less affected. By shipping raw product to centralized locations, these processors are able to maintain a more consistent product supply and better use their factory capital and work force. They are likely to be less affected by localized disruption in supply, but will still be affected by marine reserves that change the total amounts of fish available for harvest.

4.4.6.6 Effects on Communities

The effects on communities of implementing a rights-based management system in the groundfish fisheries are described in Alternative 5. The establishment of marine reserves would create additional impacts. Marine reserves would be expected to have a positive effect on the long-term productivity of groundfish stocks, which affects the abundance of fish in the future. Consequently, this measure could help ensure harvests for future generations and the sustained participation of communities in groundfish fisheries. If, however, marine reserves resulted in substantial decreases in groundfish catches over the short term, the economic hardships that fishing families and other members of West Coast fishing communities are experiencing under the *status quo* would be worsened.

4.4.6.7 Effects on Consumers of Groundfish Products and Other Segments of the American Public

Consumers would also be expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system. In addition, over the long term, marine reserves that effectively increase the size and variety of seafood species could make consumers better off. On the other hand, large marine reserves could substantially decrease seafood supply enough to make consumers worse off, at least in the short term (Carter 2003). Both the intensity of this negative effect and the probability of its occurrence are uncertain. The

most likely result of a decrease in the groundfish catch would be a negative effect on the U.S. seafood trade balance, because more groundfish products would be imported to offset the reduced domestic supply. For example, similar products from South America, Mexico and Canada could potentially substitute for West Coast production.

The price elasticity of demand for groundfish products is fairly high in the U.S. market, but assuming that demand is not perfectly elastic, the decreased production could result in higher product sales prices and a loss of consumer surplus (i.e., net benefits) to the American public. The magnitude of that loss would depend on price elasticities that are not quantifiable at this time and on the degree to which production shifted toward or away from the export markets.

Marine ecosystems and species associated with them provide a broad range of benefits to the American public (National Research Council 2001). Some of the goods and services these ecosystems produce are not exchanged in normal market transactions but have value nonetheless. For example, in addition to supporting commercial fisheries, these ecosystems support an array of recreational fishing and subsistence activities as well as non-consumptive activities such as wildlife viewing and research and education (Carter 2003; Parrish et al. 2001). Furthermore, some people may not directly interact with the marine environment, but derive satisfaction from knowing that the structure and function of that environment is protected.

A primary result of this alternative would be to provide increased protection for habitat and the overall ecosystem. In particular, the marine reserves increase protection for a large number of species and their interrelationships and provide for the maintenance of natural processes. In turn, these positive effects on marine ecosystems and associated species would be expected to lead to a significant increase in the levels of the range of benefits these ecosystems and species provide. However, changes arising from no-take reserves are difficult to predict and cannot be quantified at this time. Further research in these effects is needed.

It is also important to note that some individuals may hold religious or philosophical convictions that humankind has an ethical obligation to preserve species and ecosystems, notwithstanding any utilitarian benefits. While additional surveys and polls are needed to better understand the values and motives underlying public support of measures that protect marine species and ecosystems, Parrish et al. (2001) note that a 1999 survey conducted by the Mellman Group for SeaWeb found a high level of approval for the establishment of marine reserves. Seventy-five percent of the individuals surveyed favored having certain areas of the ocean as protected areas; 60% believed that there should be more marine sanctuaries; and 3% believed there were already too many marine sanctuaries. Survey respondents cited the following as convincing reasons for creating MPAs: 1) distinctive areas should be protected similar to what is done for national parks (65%); 2) less than 1% of U.S. waters are in MPAs

(63%); 3) MPAs would be an important step in improving the health of oceans (58%); 4) harmful activity should be restricted to preserve ocean beauty for future generations (57%). Support for MPAs diminished by only 1% when respondents were first read a statement outlining potential negative socioeconomic effects of creating MPAs and increased by 6% when respondents were first read a statement outlining potential positive effects of creating MPAs.

4.4.6.8 Effects on Fishing Vessel Safety

The establishment of ITQs for groundfish species would be expected to promote vessel safety compared to the *status quo* by reducing the pressure to fish under dangerous conditions and increasing the ability of fishers to pay for vessel maintenance and safety equipment (See Alternative 5 discussion of fishing vessel safety.) On the other hand, the establishment of marine reserves may result in a reduction in fishing vessel safety (compared to the *status quo*) if the closure of fishing grounds results in vessels fishing farther from port and possibly in more hazardous areas. The adverse effects on safety of human life at sea would be more extreme for smaller vessels. For example, recreational boats are typically smaller than commercial or charter boats, and, if marine reserves force recreational boats to travel greater distances or further offshore, risks to this group could increase substantially. The net effect of the various measures on fishing vessel safety is uncertain.

4.4.6.9 Effects on Management and Enforcement Costs

The tracking, monitoring and enforcement activities associated with a rights-based system are expensive (See Alternative 5 discussion of management and enforcement costs). Full (100%) observer coverage would be used to monitor the harvest of each participant and ensure that all catch and bycatch is monitored and recorded. This level of observer coverage would also facilitate enforcement of a full retention regulation. Any observed discarding of groundfish would be an offense. A possible concern to NMFS is the implications of having observers directly involved in monitoring compliance with discard restrictions. Doing so may require observers to assume an enforcement role, which is not consistent with current objectives of the groundfish observer program.

According to Parrish et al. (2001), the enforcement costs of establishing MPAs will vary with the following factors:

1) the number, size, and shape of the MPAs;
2) types of activities restricted and allowed;
3) degree of change the MPAs require as compared to current usage of the area;
4) proximity of the MPAs to other activities such that public surveillance can occur or there will be an enforcement presence in the area for other reasons; and
5) the types of activities enforcement is diverted from in order to enforce MPAs (unless new funds are made available for enforcement).

The costs of enforcing marine reserves and other MPAs have been declining due to the decreasing costs of technologies such as vessel monitoring systems (VMS) (See Alternative 1 discussion of management and enforcement costs).

Restricting recreational fisheries in MPAs would increase regulatory complexity and the monitoring and enforcement costs associated with these fisheries. Although many recreational vessels carry the necessary electronic equipment to chart their location, monitoring compliance in the recreational fisheries may be costly. Unless VMS requirements were extended to include recreational vessels, the existing methods of patrolling sea areas either by airplane or ship would have to be used to monitor and enforce closed areas. At-sea monitoring would be more expensive and less effective than using VMS.

Comprehensive baseline and post-implementation studies of marine reserves are necessary to determine their biological effects (Parrish et al., 2001). The costs of monitoring MPA effectiveness are difficult to evaluate at this general level of discussion and will primarily be dependent upon the number and size of reserves and the number of significant types of habitat encompassed in the marine reserves. As an example of expected costs, $80,000 was spent for a one-time only survey of the bottom habitat in deep water (25 m to 100 m) inside and outside the Big Creek Ecological Reserve off central California; this represented about 25 square kilometers of total study area (Parrish et al. 2001). An additional $300,000 was spent to collect baseline information on fish abundance, diversity, and size composition in and out of the reserve in deep water over two years following establishment of the reserve. Parrish et al. (2001) note that with larger MPAs, there is potential for using cooperative industry/agency research platforms for extractive monitoring.

An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection. The current program recently received additional funds so that its 2004 total budget is about $3.4 million ($2.2 million in federal dollars and $1.2 million from Oregon, Washington and California). However, it estimated that the program would require an additional $1 million to develop a comprehensive coastwide marine recreational fisheries data collection system (Russell Porter, PSMFC, pers. comm., Oct. 30, 2003).

4.4.7 Social and Economic Impacts of Alternative 7 (*Preferred* - Sector allocations, vessel catch limits, future IFQ)

Alternative 7 combines features of Alternatives 1, 4 and 5. The policy goal of this alternative is to reduce bycatch by setting annual catch limits for the various fishery sectors and then rewarding those sectors with the least bycatch with greater fishing opportunities. Fishery sectors would become the primary management unit and overfished species mortality limits would be set for each

sector. The definition of "trip limit" would be revised to include catch limits, which would refer to a species mortality limit as opposed to a retention limit. Initially, catch limits would likely be established for overfished groundfish stocks; over time, as the monitoring infrastructure comes online, additional species could be added. Ultimately, individual fishing quotas or *DEDICATED ACCESS PRIVILEGES* would be established for those sectors and vessels the Council deems appropriate. Vessel catch limits would established for vessels that carry an observer at the vessel's expense. These would be set for each two-month period (or other amount of time), and would expire at the end of each period (just as trip limits expire). Trip (retention) limits for non-overfished groundfish would be used in combination with vessel catch limits. Vessels with catch limits and observers would have larger trip limits for non-overfished species than those vessels that do not. A fishing sector would be closed when any catch limit for that sector is reached or projected to be reached. Other sectors would continue fishing unless an overall OY is reached.

Vessel catch limits are expected to be an incentive to carry observers, because eligible vessels would get a guaranteed portion of the sector allocations for overfished species and larger trip limits for other groundfish. These catch limits would enable the vessel to alter its strategy and gear to stay within the cap without the risk of being closed by other vessels' high bycatch rates. This could be especially important if sectors are large and include diverse fishing strategies. For example, vessels predominantly fishing deepwater species (e.g., Six-month complex) may want not to be lumped with vessels fishing nearshore flatfish. The sectors themselves may not be limited entry units; that is, once a sector is closed, a vessel having permits to fish within another open sector may be free to do so.

Fishery monitoring would be increased over Alternatives 1 through 3, thus costs would be higher. Alternative 7 would allocate specific annual amounts of overfished groundfish to each identified fishery sector and treat these as hard limits that may not be exceeded (as Alternative 4).

Eight commercial fishing sectors are identified under the current regulations: limited entry trawl; limited entry longline; limited entry pot; three whiting sectors (catcher processors, motherships and shore-based); open access; and tribal. In addition, the recreational sector must be addressed and limited to protect the other sectors' allocations. These sectors could be subdivided or combined and may be subdivided by geographical area.

4.4.7.1 Effects on Fishers' Incentives to Reduce Bycatch

Under this alternative, those limited entry vessels without catch limits could continue to discard, but observers would record bycatch data which would be used to update the NOAA Fisheries bycatch model. When a sector reaches (or is projected to reach) any limit, all vessels in that sector must stop fishing for groundfish for the remainder of the year (or until otherwise allowed to start

again). Under this alternative, the risk is reduced that one sector's harvest would affect the fishing opportunity of other sectors. However, the catch of overfished species by individual vessels within each sector could negatively affect other vessels in the sector. In the short term, observer bycatch information will not be available during the fishing season, and landings data of non-overfished species would be monitored as proxies for overfished species. (It is assumed that unobserved vessels would consider it prudent to discard overfished species so that catch would not enter the PacFIN landings data system.) As under the no action alternative, the Council's GMT would monitor landings of target species throughout the season and apply the assumed bycatch rates. Under this alternative, these data would be evaluated sector by sector. Post-season analysis using updated bycatch rates will be necessary to determine if any sector exceeded any allocation; trip limits for the upcoming season would be adjusted as appropriate to maintain the allocation shares. Allocations could also be adjusted. Over time, as the observer program is upgraded to provide inseason bycatch data, bycatch rate adjustments could be made during the season as well. That could result in greater insecurity about how long the season will remain open. For example, a single disaster tow of an overfished species, if observed, could cause an entire sector to be shut down. Although the possibility of a race for fish would be limited by the continued use of trip limits, it is likely that unobserved vessels would attempt to maximize their revenues as early in the year as possible.

Observed vessels would have larger trip limits for non-overfished groundfish and would thus have incentive (and increased revenues) to pay the costs of observer coverage.

It is clearly in the best interest of all vessels within a sector to reduce the catch of overfished species. However, in the absence of individual limits, there may be economic factors that reduce the incentive of individual vessels to be more selective in what they catch. A vessel captain who takes actions to reduce bycatch bears the full costs of deploying more selective gear and searching for cleaner fishing grounds. While some benefits of minimizing the capture of unwanted fish (e.g., less handling time) accrue solely to the individual that incurs these costs, the benefits of avoiding closure of the fisheries to the sector are spread across all vessels. The free-riders that did not adopt more selective fishing methods (or even eschew bycatch reduction methods they use under the *status quo*) may develop a competitive advantage over those that do, by incurring fewer operating costs and/or increasing their share of the catch limit. Continued use of trip limits would limit the likelihood of this occurring. If the free-rider problem resulted in a noticeable redistribution of profits across the sector, no one would be motivated to continue to invest in fishing practices that reduce the catch of overfished species and other unwanted fish. However, only unobserved vessels could be free riders.

Vessels opting to provide for their observer coverage would be protected from not only free riders, but also from other vessels of the sector they would otherwise be

part of. By establishing individual vessel caps for overfished species, vessels have a much greater incentive to avoid those species. In addition, they would also have access to larger amounts of non-overfished species so long as they avoided reaching any catch limit. In the absence of vessel caps, vessels within a sector would be expected to move away from high bycatch areas, and peer pressure by other vessels in the sector could be exerted on those who are reluctant to move. However, without formal constraints and due to the lag time in availability of observers' bycatch data, there may be enough incentive to ignore the bycatch reduction goals. If some vessels contribute to the joint bycatch reduction effort while others free-ride, the provision of the collective benefit is less than optimal (Ostrom, 1990). Individual caps for overfished species would effectively prevent the free rider issue, allowing cooperative patterns of behavior to emerge. For example, vessel owners and captains within a particular sector may be more willing to exchange fishing information, such as the location of bycatch hotspots (Gauvin et al., 1996).

The free rider problem would be less in sectors that consist of a relatively small number of participants with common interests, such as the whiting catcher-processor fleet. In such situations, negotiation of voluntary cooperatives might be feasible. The formation of cooperatives could further facilitate collective efforts by industry to reduce bycatch. For example, vessels could pool their catch limits to provide a larger buffer in case of an unpredictable bycatch encounter. Also, contractual arrangement among cooperative members may restrict the harvest of target species in areas of high bycatch to member vessels with low bycatch rates as an incentive to promote cleaner fishing practices. Cooperative members could rely on civil law to enforce contract terms. The catcher-processor sector of the Pacific whiting fishery currently uses a cooperative structure to limit salmon bycatch and actively shares information on incidental catch of other overfished groundfish species as well.

An added economic incentive for fishers to take collective action to fish more selectively under this alternative is that, in addition to the larger trip limits, a portion of some OYs could be reserved for the sector(s) or vessels with the lowest bycatch.

4.4.7.2 Effects on Commercial Harvesters

Close monitoring of sector caps for overfished species could further constrain harvest of co-occurring healthier groundfish, especially if sector participants ignored incentives and did not apply bycatch-reducing fishing tactics. A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. On the other hand, more desirable species such as yellowtail rockfish are often harvested below cumulative catch limits, due to constraints associated with overfished species. This and other healthy stocks could be more accessible if sector bycatch reduction efforts were successful. In addition, the total amount of fish available for harvest would be expected to

increase slightly as assumed/estimated bycatch rates are replace by actual counts. Currently, an annual landed catch OY may be set below the ABC to account for the expected bycatch. (In 2004, only total catch OYs were set; in some previous years, landed catch OYS were set.) By improving bycatch/discard monitoring and reporting, in the longer term Alternative 7 could reduce the need for bycatch adjustments because discarded fish could be counted towards OYs in-season through real-time observer reporting.

Expanded observer coverage would impose significant additional operating costs on vessel owners opting for a pay- as-you-go system. (Processing vessels in the Pacific whiting fishery operate this way.) Depending on implementation measures, the vessel owner could be responsible for making arrangement with an observer employment firm that provides the required observer services and for paying all associated costs (PFMC, 2003e). Even vessels that do not opt for catch limits and larger trip limits, and therefore do not pay the direct costs of observer coverage, may incur substantial indirect costs. At a minimum, it is likely that observer food costs will be borne by the vessel. Limited bunk space may require vessel operators to reduce the number of crew in order to accommodate observers, resulting in a decrease in the operating efficiency of the remaining crew. Vessels may also incur costs if they choose to carry additional liability insurance. These costs would vary between individual vessels, depending on the insurance carriers' minimum allowed coverage period, and the coverage approach that is taken (PFMC, 2003e).

It is likely that the smallest groundfish vessels would be unable to use the catch limit/larger trip limit for a variety of reasons. Some vessels are simply too small to accommodate an observer. Also, they might be unable to generate enough additional revenue to cover the additional costs. Vessels with the least revenue may be excessively burdened if required to carry an observer over an extended period of time, even if the observer is provided by NMFS. Electronic monitoring technology, such as the installation of tamper-proof video cameras on board vessels to record activities at sea, may prove to be a viable option for monitoring catch and discards (Appendix C).

The economic effects of this alternative on commercial harvesters may also vary by sector, depending on the mechanism for allocating the allowable catch. For example, managers may consider gear impacts, efficiency, and other factors in determining the percentage allocation of harvest for each sector. Sectors consisting of vessels that use relatively clean fishing methods and generate overall gains for the fisheries (e.g., produce a higher value product, have a lower impact on juvenile stocks, result in minimal habitat disturbance) could receive a larger allocation.

Such preferential allocations may induce each sector to engage in rent-seeking behavior. Lobbying efforts to acquire the maximum allocation possible may be costly. For instance, fishers may sacrifice even more valuable fishing time to

attend Council meetings, and industry associations may acquire the services of lawyers and lobbyists to help the association influence decisions on the allocation of catch limits (Anderson, 1992).

The allocation of catch limits to individual sectors and the opportunity to pool individual vessel catch limits could lead to cooperative patterns of behavior besides those directly related to reducing bycatch. In particular, sector members may form private agreements, allocating transferable harvesting privileges, as was done by catcher-processors in the Pacific whiting fishery. The allocation of transferable privileges through private agreement generates benefits for commercial harvesters similar to those that might be generated under an ITQ program (See Alternative 5 effects on commercial harvesters). Unlike ITQs, however, the distribution of fishing privileges and the system for trading, selling, or enforcing them is decided by the parties to the agreement.

Sullivan (2000) states that the ability to negotiate private agreements allocating harvesting privileges depends on certain conditions being met, including: 1) a relatively small number of participants, with a sufficient community of interest to make negotiations feasible; 2) an adequate system for gathering fishery harvest data, and adequate data verification and transparency to monitor compliance and enforce it in cases of non-compliance; 3) significant barriers to prevent new participants from entering after shares have been negotiated, or else free riders are almost certain to take advantage of the fishermen who rationalize their harvest; 4) an opportunity to attain additional value through an allocation agreement; and 5) for antitrust law reasons, when the arrangement includes one or more vertically integrated producers operating in a U.S. fishery, assurance that the relevant fishery sector's target species or incidental catch allocation(s) will be limited and fully harvested.

Once an agreement is negotiated, the parties to the agreement must have internal rule-making capability and sanctioning authority to deter those who are tempted to break the rules (Ostrom,1990). Quota shares could be created by using contracts and relying on civil law to enforce contract terms, including penalties (e.g., expulsion from the agreement) for vessels that exceed their quota holdings.

Leal (2002) states that one advantage private harvesting agreements have over an ITQ program is avoidance of the expensive rent-seeking behavior that often accompanies allocation of ITQs. Although this process may not be free from controversy, it appears to be easier for the individual participants to allocate individual shares than to have the government do it. On the other hand, Leal (2002) notes that private harvesting agreements may also have some disadvantages in comparison to ITQs. A new entrant can simply buy or lease ITQs from a quota owner willing to sell or lease. In contrast, with a private harvesting agreement, the transfer of shares to a new entrant will require becoming a party to the agreement. In addition, ITQs may be likely to remain in force, especially once they acquire value through the secondary market. By

contrast, the durability of private agreements depends on the willingness of parties to maintain the agreement. Even when the arrangement has no sunset provisions, or requires a majority of members to rescind it, members may not retire as many redundant vessels or invest in as much of the product enhancement capital as they would under a system of ITQs.

The cooperative patterns of behavior that may develop under this alternative are expected to generate economic benefits for commercial harvesters. These benefits may render some commercial harvesters better able to sustain the costs of an observer requirement. In addition, increased observer coverage may allow more vessels to process seafood products at sea. It is uncertain whether the presence of observers would lead to a relaxation of state restrictions on at-sea processing. Investments in freezing capacity could lead to significant increases in revenues for some vessel owners (OCZMA, 2002). For example, sablefish commands substantially higher prices when frozen at sea. However, even if all the possible economic benefits under Alternative 7 are realized, it is likely that paying observer costs would not be economically feasible for many vessels.

4.4.7.3 Effects on Recreational Fisheries

This alternative may or may not have negative economic effects on recreational fishers relative to Alternative 1. Under the no action alternative, the recreational fishery is managed under harvest guidelines for canary rockfish, bocaccio, lingcod and other species. The Council and states try to keep recreational catches from exceeding these amounts, often resulting in unexpected closure of the recreational fishery. Improvements in the recreational catch monitoring program may either reduce or increase the likelihood of restrictions. Under Alternative 7, NMFS' ability to detect excessive catches within the sector may be enhanced by improvements to the recreational monitoring program.

Closure of the recreational fishery results in fewer fishing experiences for private anglers and charter fishing patrons. The ability of the recreational sector to avoid a fishery closure by controlling catch of overfished species through an incentive program is likely to be limited, because there are many and diverse participants.

Dividing the recreational sector into geographical (e.g., state-based) subsectors could mitigate some of the negative effects of this alternative, particularly for Washington and Oregon. Recreational catches in those states have been relatively steady and predictable compared to California. Recreational fishers in the north could have greater security about their fishing opportunities if separate allocations were established.

4.4.7.4 Effects on Tribal Fisheries

Tribes are effectively a specified sector, with sablefish and whiting allocations that are functionally similar to species caps. The Tribes' allocations and

anticipated catches of overfished species are not considered caps under the no action alternative. Alternative 7 would not change the amounts of any allocations. However, it could establish allocations of overfished species such as canary, yelloweye and widow rockfish. If allocations were treated as caps under Alternative 7, they could have an adverse economic effect on Tribal fishers, especially the Makah Tribe, if the Tribal Pacific whiting or sablefish fishery were closed as a result of early attainment of an overfished species cap. There has been some catch of canary rockfish, widow rockfish, and dark-blotched rockfish in the whiting fishery. In most recent years, whiting provided the lion's share of harvest tonnage and a major portion of ex-vessel revenue. Consequently, the economic impacts of a fishery closure could be severe.

4.4.7.5 Effects on Buyers and Processors

The economic effects on buyers and processing companies are uncertain because of the uncertainty as to whether vessel owners within sectors and those with individual catch limits can successfully manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing tactics, higher catches in the groundfish fisheries are expected. Any substantial increase in landings could eliminate upward pressure on ex-vessel prices; however, the potential for large increases appears unlikely in the near future. Greater throughput over constant fixed costs will result in lower average costs for processing facilities.

On the other hand, if a single disaster tow shut down an entire fishing sector, buyers and processors may experience significant shortages of fish. Current fish processing infrastructure could be disrupted if the trawl fishery accelerated early in the season under this alternative (although trip limits would tend to prevent that.)

4.4.7.6 Effects on Communities

To the extent that commercial harvesters were able to prosecute groundfish fisheries without being shut down, this alternative would not be expected to have a significant economic impact on communities. The groundfish fisheries would continue to benefit fishing communities as under the *status quo*. However, if sector closures did occur, there would likely be negative impacts in fishing communities, particularly if processing plants are also forced to close.

4.4.7.7 Effects on Consumers of Groundfish Products

If this alternative did not result in early closures of major harvesting sectors, it would be expected to have little impact on consumers relative to the *status quo*, as the price per unit, product availability, and product quality would be unlikely to change substantially. However, if major fishing sectors were shut down due to unexpected catches of overfished species, consumers could see a disruption in groundfish supplies. To the extent that supplies of fresh or live groundfish from

West Coast fisheries were curtailed, a loss of consumer surplus could occur. A reduction in supplies of frozen West Coast groundfish would be likely to have a minimal effect on consumer surplus because this product form has many more substitutes.

4.4.7.8 Effects on Fishing Vessel Safety

The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations may lead to reductions in injury and loss of life because of harvester's incentives to take fewer risks and use their best judgment in times of questionable weather conditions. An intense race for fish appears unlikely; although fishers would likely increase their effort early in the year when weather conditions may increase risks. The could result in a reduction in the safety of fishers while at sea. On the other hand, early closure of a sector would reduce the amount of time those vessels were at sea, resulting in increased safety.

4.4.7.9 Effects on Management and Enforcement Costs

Alternative 7 would be expected to notably increase management and enforcement costs for initial start up and over the long term. The sector allocations required by this alternative would take two to four years to develop, analyze, and implement through the Council and NMFS management processes. In addition, human costs associated with inseason catch projections would be greatly increased in order to track multiple sectors inseason. As catch limits were allocated over an increasing number of sectors, NMFS would be required to manage increasingly small blocks of fish. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. In the short term under Alternative 7, the PacFIN quota species monitoring (QSM) program would have to be revised to track each sector's landings independently. Catches of overfished species would be projected based on landings of target species; each sector would likely have different assumed bycatch rates. If sectors are open, meaning vessels would be free to move from one to another without warning, catch monitoring could become even more complex and difficult. Over time, as observer coverage and associated infrastructure improves (at additional cost), sectors may be managed in real time. This would increase the pressure on observer data whenever new information indicated increased bycatch rates. An expanded port/field sampling program could improve inseason estimates of recreational catch. It would also be necessary to have adequate observer coverage of every sector's vessels to ensure the effectiveness of sector caps.

As discussed above in the analysis of the economic effects on commercial harvesters, the costs of expanded observer coverage would be borne mostly by industry, unless NMFS provided all observers at no cost to vessels. Federal funds for expansion of the observer program have not been identified. In addition, the increase in the number of observers and its associated increase in the amount of

data collected is expected to raise overall annual costs of the groundfish observer program. This budgetary increase can be attributed to additional staffing and augmented spending for data entry contracts. To monitor the catch of each vessel requires the use of increasingly sophisticated catch-monitoring tools, such as electronic reporting. Computerized systems of electronic reporting and data management increase the quantity, quality, and timeliness of the information available for fisheries management. However, they also increase the demands on management staff to effectively make use of a larger and more complex data system. These additional costs to the observer program have not been estimated.

An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection. The current program recently received additional funds so that its 2004 total budget is about $3.4 million ($2.2 million in federal dollars and $1.2 million from Oregon, Washington and California). However, it estimated that the program would require an additional $1 million to develop a comprehensive coastwide marine recreational fisheries data system.

4.4.8 Data Gaps and Information Needs

As discussed previously, there may be insufficient information to comprehensively assess the economic consequences of existing or expanded measures to mitigate bycatch in the groundfish fisheries. This section will outline the data requirements needed to frame a more complete economic impact assessment.

The following quantitative data would support the analysis of the economic effects of the alternatives. In some cases, time series data would be useful to compare the economic status of the groundfish fisheries before and after implementation of existing management measures that have affected the level of bycatch. These data would also provide a benchmark that would allow before-and-after comparisons if alternative measures were implemented.

- Estimates of excess harvesting and processing capacity (including latent capacity of inactive vessels) derived from information on the quantities of capital equipment purchased and maintained by plants and vessels, their activity levels in various fisheries, and variable input use (for items such as labor, fuel, fishing gear, and other essential inputs). These estimates should be by sector and vessel length category.
- Average sale price of groundfish license by vessel designation, length category, gear type, and area endorsement, 1995-2004.
- Estimates of the economic effects of groundfish bycatch in groundfish and other fisheries using bio-economic, multi-species models that incorporate data on biological interactions, effort levels, catch and bycatch rates, and catch values.

- Model-based estimates of the economic effects of introducing dedicated access privileges (catch limits and ITQs) in the fisheries, including changes in the size, structure, location, and profitability of the fleet.
- Information on the current economic performance of the fleet and individual vessels and processors, including disaggregated income, cost, and employment information from harvesting and processing firms.
- Vessel and processing facility ownership data to monitor changes in concentration of ownership in the harvesting and processing sectors, the structure of ownership (including proprietorships, publicly traded corporations, and privately held corporations) and the relationships both within firms (i.e., the amount and nature of vertical and horizontal integration) and among firms.
- Data to measure the willingness to pay (demand) for recreational fishing experiences of varying quality.
- Data on the relative economic importance of fisheries (salmon, crab, groundfish, and pelagic species) to individual fishing vessels and processing companies in various ports, and information on the amounts of product processors acquire from local and outside sources.
- Model-based estimates of the economic effects of establishing marine reserves using information on the location and magnitude of current harvest and effort, travel costs to different fishing grounds and the extent to which fishermen can relocate to other areas.
- Estimates of the existence value and other non-consumptive values attributed to resources within proposed marine reserves.
- Information on the dependence of families in various communities on income from fishing, alternative sources of income, and resources available in communities to assist families in adapting to change.
- Information on the costs and effectiveness of alternative onboard electronic monitoring technology to monitor catch and discards, including video recording devices.
- Information on the costs and effectiveness of alternative industry reporting and recordkeeping requirements to monitor catch and discards, including vessel logbooks.

4.5 Summary of Impacts of Alternative Monitoring Programs

Data Reporting, Record-keeping, and Monitoring are summarized in Table 4.5.1 and briefly described below:

1. **Alternative 1** 10% coverage of commercial fleet, 100% coverage of at-sea whiting catcher/processor fleet.
2. **Alternative 2** Same as Alternative 1, except some marginal increase in coverage due to fewer vessels.
3. **Alternative 3** Same as Alternative 1, except some marginal increase in coverage due to fewer trips**.**
4. **Alternative 4** Significant increase in observer coverage with allocation among fishery sectors and increased recreational sampling
5. **Alternative 5** 100% observer coverage of commercial fleet and charter boats.
6. **Alternative 6** 100% observer coverage of commercial fleet and charter boats.
7. **Alternative 7** Significant increase in observer coverage with allocation among fishery sectors and increased recreational sampling

Effectiveness of tools to improve accountability are ranked by alternative in Tables 4.5.1 and 4.5.2

Table 4.5.1. Monitoring tools and effects on improving accountability and cost impacts of each tool. Effects scaled as follows: Y (definitely, substantially), y (probably, moderately), n (probably not, minor), and N (no, none); L = lower cost, M = moderately higher cost, H = highest cost.

Monitoring/Reporting Requirements	Alternatives	Program	Identify fishing locations	Identify fishing depths	Provide tow by tow data	good data quality	Increase quantity and timeliness of data	Identify groundfish discards	Provide groundfish biological data	Provide non-groundfish data	Provide other non-finfish data	Provide mammal and seabird data	Ease of enforcement	Administrative Costs	Compliance Costs (to industry)
fish tickets	1-6	state	N	N	N	y	Y	N	N	y	N	N	Y	L	L
logbooks	1-2,4-6	state	y	y	y	y	n	N	N	N	N	N	Y	M	M
logbooks	3	federal	y	y	y	y	y	y	N	N	N	N	Y	M	M
observers															
commercial 10%	1-3	federal	Y	Y	Y	Y	n	Y	Y	Y	Y	Y		H	M/H
commercial 60%	4	federal	Y	Y	Y	Y	y	Y	Y	Y	Y	Y		H	M/H
commercial 100%	5,6	federal	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		H	M/H
CPFV	4-5	(state)	Y	y	-	Y	Y	Y	Y	Y	Y	y		H	M/H
sport		n/a			-		-							HH	
port sampling															
commercial	1-6	state	y	y	N	Y		n	y	N	N	N		M	L
CPFV	1-6	state	y	y	-	Y		n	y	y	N	N		M	L
sport	1-6	state	y		-				y?	y?				M/H	L
VMS	1-6	federal	Y	y	N	Y	Y	N	N	N	N	N	Y	L	M
mandatory retention	5,6	federal				Y	Y	y	y	n	n	N	N	H/M	M/H
Enforcement cost			H	H	H			H		H	H				

Table 4.5.2. Monitoring alternatives and rank of effects on improving accountability, and cost impacts of each alternative.

	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**	**Alternative 6**	**Alternative 7**
RELATIVE RANK OF ALTERNATIVES BY EFFECTIVENESS AT IMPROVING ACCOUNTABILITY, EASE OF ENFORCEMENT, REDUCING COMPLIANCE COSTS	10% commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, VMS.	10% commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, VMS.	10% commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, 100% log coverage, log verification, VMS.	60% commercial and recreational (CPFV) observer coverage, increased commercial and recreational port sampling, catch projections based on fishtickets and some in season estimates of discard and in-season observer data, VMS.	100% commercial and recreational (CPFV) observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.	100% commercial and recreational (CPFV) observer coverage, commercial and increased recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.	>10% commercial and recreational (CPFV) observer coverage, increased commercial and recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.
Indentify fishing locations (VMS)	1	1	1	1	1	1	1
Identify fishing depths (VMS)	1	1	1	1	1	1	1
Provide tow by tow data	2	2	1	1	1	1	1
Provide good quality data	4	4	3	2	1	1	2
Increase quantity of data	5	4	3	2	1	1	2
Allow inseason use of data	3	3	3	2	1	1	2
Identify groundfish discards	5	4	3	2	1	1	2
Provide groundfish biological data	6	5	4	3	2	1	3
Provide non-groundfish biological data	3	3	3	2	1	1	2
Provide non-finfish biological data	3	3	3	2	1	1	2
Provide mammal and seabird data	3	3	3	2	1	1	2
Ease of enforcement	5	4	3	2	1	1	2
Keep administrative costs low	2	3	4	5	6	6	4
Keep industry compliance costs low	2	3	4	5	6	6	4
Rank of location	2	2	1	1	1	1	1
Rank of quality, quantity, timeliness	5	4	3	2	1	1	2
Rank of groundfish biological data	6	5	4	3	2	1	3
Rank of non-groundfish biological data	3	3	3	2	1	1	2
Rank of ease of enforcement	5	4	3	2	1	1	2
Rank of cost	1	2	3	4	5	5	3 to 4
Number of first place scores	2	2	4	4	15	17	4
Number of last place scores	15	8	5	0	3	3	0
Overall Rank	6	5	4	3	2	1	3

Overfished Groundfish Under the Alternative 1 observer program, total catch estimates of overfished species are highly variable for several reasons. Most of the species are highly aggregating rockfish and population abundance is low, thus tow by tow variability is quite high. WCGOP was initiated in the fall of 2001 and depends on accumulation of observed tows to stabilize variability (NMFS 2003). A complete estimate cannot be made until after logbook and fish ticket data are acquired, some months after the fishing season is over. Status quo monitoring improves previous bycatch estimates, which were based on dated studies. In spite of sampling limitations, these estimates better reflect current population levels, management, and fishing strategies.

Amendment 16-2 (PFMC 2003c) discusses status quo bycatch monitoring of overfished species (see section 4.3.1.2). One of the primary concerns with bycatch monitoring is that rebuilding of overfished species is sensitive to actual bycatch rates. Total catch must be accounted for accurately for rebuilding to be successful. Under status quo, observer coverage is available for about 10-20% of the commercial fleet. (100% of at-sea Pacific whiting catcher processors have observer coverage.) As was pointed out in the Amendment 16-2 EIS, if bycatch estimates are underestimated, rebuilding progress will be compromised (PFMC 2003c). On the other hand, if they are overestimated, trip limits and available harvest of overfished and healthy stocks of groundfish will be lower, bycatch and bycatch mortality will be higher, and there will be indirect negative socioeconomic impacts. Low OYs for some species make it imperative to improve accounting of catch and bycatch.

Alternatives 2 and 3 assume the same number of observer days would be applied to fewer trips, due to either a reduced fleet size (Alternative 2) or reduced seasons (Alternative 3). This would have the effect of increasing the proportion of total trips having observer coverage. Some marginal improvements should occur in tracking of overfished species.

In Alternatives 4 and 7, the observer program would be modified to ensure adequate coverage of all sectors. In addition, the data compilation and analysis functions would be augmented with the intent to move towards providing catch and bycatch data for inseason management. Costs associated with both aspects would be significantly higher than expected under Alternatives 1, 2 and 3. Under Alternatives 4 and 7, observers would be placed on a subset of each sector, and observed catch rates extrapolated (expanded) to the entire sector. Recreational sampling would also be increased. These modifications would have a direct effect of reducing bycatch of overfished species compared to the first three alternatives. Bycatch mortality of overfished species may also be reduced in the commercial fishery compared to the first three alternatives, as fishers are likely to retain catches.

Alternatives 5 and 6 provide 100% observer coverage of the commercial fleet and increased monitoring of the recreational charter boat fleet. In-season monitoring

of commercial and recreational fisheries would ensure caps would not be exceeded by any given fishing vessel. These controls would have a direct effect of reducing bycatch of overfished species compared to the first four alternatives. Bycatch mortality may also be reduced in the commercial fishery compared to the first four alternatives, because fishers are more likely to retain catches.

Although coverage of the charter boat fleet is increased, some bycatch mortality of rockfish caught and released in the recreational fishery would occur. Bycatch mortality of lingcod is thought to be less than for rockfish, because lingcod do not possess a swim bladder.

Costs for Alternatives 5 and 6 are significantly higher than Alternatives 1-3 and somewhat higher than Alternative 4. Costs for Alternative 7 would fall somewhere between Alternatives 4 and 5.

Emphasis Species Several species of groundfish co-occurring with overfished species or species under precautionary management are constrained in an effort to control harvest of species of concern. Ratio management seeks to predict catch of overfished species and those under precautionary management relative to target species in order to scale and proportion trip limits. Under Alternative 1, if observer coverage and monitoring efforts result in over estimation of the bycatch of overfished species or species under precautionary management, trip limits for healthy stocks such as shelf rockfish, Petrale sole, Dover sole, sablefish, and longspine thornyhead could be constrained more than they need to be (see discussion above under *Overfished Groundfish*) resulting in an increase in bycatch and bycatch mortality as well as negative socioeconomic impacts. Nevertheless, it is critical to improve estimates of catch and bycatch in order to provide accurate catch ratios and set trip limits that reflect these ratios.

As was described above under *Overfished Groundfish*, Alternatives 2 and 3 should have a positive impact on catch reporting of other groundfish as compared to Alternative 1. Discard information on other healthier stocks of groundfish may be improved. Currently, observers do not always collect data on the reasons for discarding fish. Managers may wish to allocate some of time spent accounting for overfished species and other groundfish (ratio estimation) towards gathering additional important data on the reasons for discard.

Alternatives 4 and 7 would improve reporting of catch over the previous Alternatives 1, 2 and 3, and should produce more precise information about regulatory, size, and market induced discard of other groundfish. The improved information should have a positive indirect impact on stock assessments of other groundfish.

Discarding of other groundfish would still be legal under Alternative 5 but not Alternative 6. Some nearshore species (such as black rockfish and cabezon) could still be discarded by nearshore commercial and recreational fleets. Thus,

the monitoring program under Alternative 5 may be slightly less effective than under Alternative 6. Full (100%) observer coverage of the limited entry commercial fleet and increased coverage of the open access and recreational fleets would provide better data on total catch of other groundfish, including discards. These alternative should substantially improve information and accountability compared to the first four alternatives. Another impact of 100% observer coverage would be timely and accurate accounting of most of the catch. Indirect impacts of 100% observer coverage would include improved stock assessments and improved data on reasons for discard that may led to new methods of avoiding bycatch.

Potential impacts to the resource due to bias in catch estimates are thought to be minimal for more abundant species such as petrale sole and English sole, because current exploitation rates are thought to be low, thus catch and bycatch are low with respect to OY.

4.6 Summary of Impacts to Biological Environment

The relative effectiveness of each alternative in reducing bycatch and bycatch mortality is summarized and compared in Tables 4.6.1 and 4.6.2.. Effect on individual fisher accountability is included.

Table 4.6.1. Relative rank of bycatch reduction methods (tools) for each alternative used to reduce bycatch and bycatch mortality, and to address accountability issues.

RELATIVE RANK OF ALTERNATIVES BY BYCATCH REDUCTION TOOL TYPE	Alternative 1 Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	Alternative 2 Reduce regulatory bycatch by increasing trip limits (reduce commercial trawl fleet)	Alternative 3 Reduce regulatory bycatch by increasing trip limits (reduce commercial season)	Alternative 4 Reduce all groundfish bycatch by establishing sector caps	Alternative 5 Reduce all groundfish bycatch by establishing individual catch caps (rights-based) and individual quotas for non-overfished species	Alternative 6 Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements	Alternative 7 Reduce all groundfish bycatch by establishing sector caps, develop individual vessel caps and increased observer coverage.
FISHERY MANAGEMENT TOOLS							
Harvest Levels							
ABC/OY based on ratios/estimated joint catch rates ("bycatch model")	1	1	1	1	1	1	1
Set **overfished groundfish catch caps** by **fishing sector**	2	2	2	1	2	2	1
Use **trip limits** to control groundfish bycatch, ratios similar to expected species encounter rates, adjusted to discourage fishing in certain areas	4	2	3	2	1	1	2
Use **catch limits** to control groundfish bycatch	3	3	3	2	1	1	2
Set individual vessel/permit catch caps for overfished groundfish species	3	3	3	1	2	1	1 to 2
Set groundfish **discard caps** (require increased retention)	2	2	2	2	1	1	2
Establish **IQs** for other groundfish	2	2	2	2	1	1	1 to 2
Establish bycatch **performance standards**	3	3	3	2	1	1	2
Establish a reserve for fishers who achieve performance standards	3	3	3	1 to 2	1	1	1 to 2
Gear Restricitons							
Rely on **gear restrictions** to reduce expected or assumed bycatch rates	2	2	2	2	3	1	2
Time/Area Restrictions	3	3	3	3	2	1	3
Establish **long term closures for all groundfish**	3	3	3	3	2	1	3
Establish **long term closures for on-bottom fishing**	2	2	2	2	1	1	2
Capacity reduction (mandatory)	3	1	3	3	2	2	3
Monitoring/Reporting Requirements							
Trawl logbooks	2	2	1	2	2	2	2
Fixed-gear logbooks	2	2	1	2	2	2	2
CPFV logbooks	2	2	2	1	1	1	1
Commercial **port sampling**	3	3	3	2	1	1	1
Recreational port sampling	3	3	3	1	2	1	1
Observer coverage (commercial)	5	4	3	2	1	1	1 to 2
CPFV observers	3	3	3	2	2	1	2
VMS	1	1	1	1	1	1	1
Post-season observer data OK	3	3	3	2	1	1	1 to 2
Inseason observer data required	3	3	3	2	1	1	1
Rely on fish tickets as the primary monitoring device for groundfish landings inseason	2	2	2	2	1	1	1
Discount fish ticket records of overfished species landings due to the low likelihood they accurately reflect actual catch and mortality.	2	2	2	1	1	1	1
Number of first place scores	2	3	4	7 to 8	16	22	9 to 14
Number of last place scores	23	20	18	12	3	3	11
Overall Rank	5	5	5	4	2	1	3

Table 4.6.2. Alternatives ranked by their effectiveness at reducing bycatch, enforcing and monitoring bycatch measures, and reducing compliance costs to industry.

RELATIVE RANK OF ALTERNATIVES BY POTENTIAL BYCATCH REDUCTION, EASE OF ENFORCEMENT AND COST	**Alternative 1** Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	**Alternative 2** Reduce regulatory bycatch by increasing trip limits (reduce commercial trawl fleet)	**Alternative 3** Reduce regulatory bycatch by increasing trip limits (reduce commercial season)	**Alternative 4** Reduce all groundfish bycatch by establishing sector caps and individual vessel restricted species quotas (RSQs)	**Alternative 5** Reduce all groundfish bycatch by establishing individual catch caps (rights-based) and individual quotas for non-overfished species	**Alternative 6** Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements	**Alternative 7** Reduce all groundfish bycatch by establishing sector caps and individual vessel restricted species catch caps (RSCs)
Reduce catch in excess of vessel limits?	5	4	5	3	2	1	2 to 3
Reduce proportion of overfished species?	5	3	4	2	1	1	2
Reduce encounters with overfished species?	5	3	4	2	1	1	2
Reduce fishing in high relief seafloor areas?	5	3	4	2	2	1	2
Reduce catch proportion of on-bottom species?	5	3	4	3	2	1	3
Reduce catch proportion of off-bottom species?	6	4	5	3	2	1	3
Reduce catch proportion of small fish?	3	3	3	3	2	1	3
Reduce catch of unwanted finfish species?	3	3	3	3	2	1	3
Reduce potential for "ghost fishing"?	1	1	1	1	1	1	1
Reduce catch of marine mammals?	2	1	2	2	2	2	2
Reduce catch of seabirds?	2	1	2	2	2	2	2
How easily enforced/ monitored?	5	4	3	2	1	1	2
Compliance Costs (to vessel)	1	2	3	4	5	6	4 to 5
Rank of Groundfish Bycatch Reduction	6	4	5	3	2	1	3
Rank of Other Bycatch Reduction	2	1	2	2	2	2	2
Rank of Enforcement	5	4	3	2	1	1	2
Rank of Cost	1	2	3	4	5	6	4
Number of first place scores	2	3	1	1	4	10	1
Number of last place scores	11	2	4	4	2	3	4
Overall Rank	7	5	6	4	2	1	3

4.7 Summary of Impacts to the Socioeconomic Environment

Table 4.7.1(a) summarizes the social and economic impacts of Alternatives 1, 2 and 3. Table 4.7.1(b) summarizes the social and economic impacts of Alternatives 4, 5, 6 and 7. The significance of the impacts of all the alternatives is described in Table 4.7.2.

Table 4.7.1(a). Summary of effects of Alternatives 1, 2 and 3 on the social and economic environment (Alternatives 4, 5, 6 and 7 in following table).

	Alternative 1	Alternative 2	Alternative 3
Incentives to Reduce Bycatch	Quota-induced discards can occur when fishers continue to harvest other species when the harvest guideline of a single species is reached and further landings of that species are prohibited. As trip limits become more restrictive and as more species come under trip-limit management, discards are expected to increase. In addition, discretionary discards of unmarketable species or sizes are thought to occur widely. However, in comparison to a race for fish allocation system, the current management regime provides harvesters a considerable amount of flexibility to reduce unwanted catch and discards.	Reducing the level of effort in the groundfish fisheries and increasing trip limits would likely reduce the level of groundfish bycatch (discard).	If trip limits increase, the level of groundfish bycatch (discard) would be expected to decline.
Commercial Harvesters	By spreading out fishing more evenly over the year, the current management regime helps maintain traditional fishing patterns. However, landings of major target species (other than Pacific whiting) are expected to continue to decline as OYs are reduced to protect overfished species. Declining harvests lead to significant decreases in total groundfish ex-vessel value.	Further fleet reduction would be expected to reduce (but not eliminate) extra capacity in the fishery and to restore the fleet to some minimum level of profitability.	A combination of higher trip limits and a reduction in the length of the fishing season would be expected to lead to an overall reduction in variable fishing costs. With larger trip limits, revenues per trip are expected to increase. However, the overall impact of this alternative on costs and revenues would depend on when individual participants were allowed to fish. For example, fishers may be unable to fish for certain species at optimal times.
Recreational Fishery	Landings of major target species are not expected to increase and may decline further if OYs are reduced to protect overfished species. Decreased harvests lead to significant decreases in recreational value.	Changes in landings of major species targeted in the recreational fishery would be expected to be insignificant.	Effects as described in Alternative 2
Tribal Fishery	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant.	Effects as described in Alternative 1	Effects as described in Alternative 1
Buyers and Processors	The current management regime reduces the likelihood that processing lines will be idle by fostering a regular flow of product to buyers and processors. However, decreased deliveries of groundfish to processors and buyers will result in significant decrease in groundfish product value.	No significant changes in the total amount of fish delivered to processors is expected. With fewer vessels in the fishery, processors would have fewer boats to schedule for landings. The related reductions in time spent unloading vessels is expected to result in cost savings. However, processors in ports that experience a reduction in fleet size may be negatively affected if they are unable to obtain supplies of fish from alternative sources	Larger trip limits would not be expected to affect the total amount of fish that harvesters deliver to processors. However, with vessels taking longer and potentially fewer trips, processors would have fewer boats to schedule for landings and unloading, reducing their average costs. On the other hand, costs could increase if processors were unable to control the flow of product throughout the year and capital is idle during closed periods.

Table 4.7.1(a). Summary of effects of Alternatives 1, 2 and 3 on the social and economic environment (Alternatives 4, 5, 6 and 7 in following table).

	Alternative 1	Alternative 2	Alternative 3
Communities	By maintaining year-round fishing and processing opportunities, the current management regime promotes year-round employment in communities. However, groundfish employment and labor income are expected to continue to decline, resulting in economic hardship for businesses involved in the groundfish fisheries. These businesses are expected continue to diversify to reduce dependence on groundfish fisheries.	The direction and magnitude of many of the economic effects on particular coastal communities are uncertain, as the distribution of the post-buyback fleet is uncertain. If further reduction in fleet capacity with higher trip limits were successful in increasing net revenues or profits to remaining commercial fishers, positive economic impacts on the communities where those fishers land their fish, home port and reside would be expected. On the other hand, some communities may experience a significant loss of vessels and a consequent decrease in income, jobs and taxes.	The impacts are uncertain, as community patterns of fishery participation vary seasonally based on species availability as well as the regulatory environment and oceanographic and weather conditions. If higher trip limits were successful in increasing net revenues or profits to fishers, positive economic impacts on the communities where those fishers land their fish, home port, and reside would be expected. On the other hand, seasonal closures could leave crew members at least temporarily unemployed.
Consumers	The current management regime allows buyers and processors to provide a continuous flow of fish to fresh fish markets, thereby benefitting consumers. Consumers of fresh or live groundfish may be adversely affected by reduced commercial landings. However, changes in benefits to most consumers of groundfish products would be expected to be insignificant due to availability of substitute products.	Effects as described in Alternative 1	Consumers of fresh or live groundfish could be unable to obtain fish from the same sources for half of the year unless the harvest sectors are split into two groups, with one group of vessels active at any given time.
Fishing Vessel Safety	Some gains in fishing vessel safety are at least partially realized under the current management regime, as fishers are able to fish at a more leisurely pace and avoid fishing in dangerous weather or locations. However, safety of human life at sea may decrease if reduced profits induce vessel owners to forgo maintenance, take higher risks or hire inexperienced crews.	Increases in net revenue to harvesters resulting from increases in trip limits may enhance their ability to take fewer risks and use their best judgment in times of uncertainty, thereby increasing vessel safety.	The effects on vessel safety may be mixed. Increases in net revenue to harvesters resulting from increases in trip limits may lead to reductions in injury and loss of life because of harvester's incentives to take fewer risks and use their best judgment in times of uncertainty. However, set seasons make it more difficult for harvesters to make wise decisions as to when and where to fish.
Management and Enforcement Costs	The management regime is expected to continue to be contentious, difficult and expensive. Technological developments such as VMS may mitigate the rate at which management costs escalate.	Costs are expected to decrease, as fewer vessels are generally easier and less expensive to monitor.	Effects will vary depending on the way the seasonal closure is structured. Costs are expected to decline if there is no fishing activity to monitor for 6 months of the year. However, there will be increased costs if permit holders are divided into groups.

Table 4.7.1(b). Summary of effects of Alternatives 4, 5, 6 and 7 on the social and economic environment. (Alternatives 1, 2 and 3 in preceding table).

	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Incentives to Reduce Bycatch	While it would be in the best interest of all vessels within a sector to reduce the catch of overfished species, a race for fish could develop in which individual vessels eschew fishing practices that reduce bycatch in order to attain their landing limits as quickly as possible. Setting individual catch limits would prevent that. In addition, if cooperative patterns of behavior emerge, decreases in bycatch would be expected.	The amount of fish discarded by each vessel would be counted against the vessel's limit. This measure provides strong economic incentives to reduce the catch of unwanted fish because it internalizes the costs of discarding fish.	Marine reserves would prohibit fishers from fishing in certain areas in order to reduce the probability that fish will be caught and discarded, while the 100% retention requirement would be the primary means of reducing groundfish bycatch (discard) outside of marine reserves. Prohibiting discard would produce a strong incentive to avoid unwanted catch because the costs of sorting, storing, transporting and disposing of fish that cannot be sold may be substantial. If vessel groundfish quotas are transferable, Alternative 6 would be similar to Alternative 5; if not transferable, negative effects would be much more significant and more similar to Alternative 4.	While it would be in the best interest of all vessels within a sector to reduce the catch of overfished species, individual vessels may forgo fishing practices that reduce bycatch in order to attain their landing limits as quickly as possible. Setting individual catch limits would prevent that. In addition, if cooperative patterns of behavior emerge, decreases in bycatch would be expected.
Commercial Harvesters	A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. However, the total amount of fish available for retained harvest would be expected to increase, as vessels would increase retention of groundfish, and the level of bycatch would be measured more accurately through expanded observer coverage. The economic benefit of increased landings must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage. The allocation of catch limits to individual sectors could lead to economic benefits if private agreements allocating transferable harvesting privileges were negotiated.	Current vessel owners as a group would likely benefit from a system that allocates freely transferable quota shares to vessel owners on the basis of catch histories. Moreover, the total amount of fish available for harvest would increase, as bycatch would be measured more accurately through expanded observer coverage. Not all vessel owners would benefit equally, and the relative benefits would depend on the allocation formula. In addition, the economic benefits must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage.	Some measures would significantly increase fishing costs, while other would reduce them. For example, 100% groundfish retention, full observer coverage, and establishment of marine reserves would increase average costs, whereas the establishment of ITQs for groundfish species would reduce costs.	A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. However, the total amount of fish available for retained harvest would be expected to increase, as vessels would increase retention of groundfish, and the level of bycatch would be measured more accurately through expanded observer coverage. The economic benefit of increased landings must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage. Establishment of allocations among sectors could lead to economic benefits if private agreements allocating transferable harvesting privileges were negotiated.

Table 4.7.1(b). Summary of effects of Alternatives 4, 5, 6 and 7 on the social and economic environment. (Alternatives 1, 2 and 3 in preceding table).

	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Recreational Fishery	This alternative may have a negative economic effect on recreational fishers if its sector catch limit were exceeded. The ability to detect excessive catches within the recreational sector would be enhanced by a CPFV observer program and expanded port/field sampling. The ability of the recreational sector to avoid a fishery closure by controlling catch of overfished species through an incentive program is likely to be limited, as there are many and diverse participants. Dividing the recreational sector into geographical (e.g., state-based) subsectors could mitigate some of the negative effects.	The creation of tradable quota shares for the commercial fishing/processing sectors is not expected to apply to the recreational fishery. The possibility of creating ITQs for recreational fishers may exist, but any discussion of how such a allocation would be achieved or its effects on recreational fishers would be speculative.	Rights-based system effects would be as described in Alternative 5. Marine reserves could benefit recreational fishers over the long term if local catch rates and fish size increased due to spillage of adults out of the marine reserves. On the other hand, if marine reserves resulted in geographic redistribution of the commercial and recreational fleets, the concentration of fishing effort in the areas that remain open could lead to localized stock depletion, reduced recreational catch per unit effort, and reduction in the quality of the fishing experience.	This alternative may have a negative economic effect on recreational fishers if its sector catch limit were exceeded. The ability to detect excessive catches within the recreational sector would be enhanced by improved port/field sampling. Incentive programs are likely to be limited, as there are many and diverse participants. Dividing the recreational sector along geographical boundaries could mitigate some of the negative effects.
Tribal Fishery	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant.	Effects as described in Alternative 1	Effects as described in Alternative 1	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant. However, potential effects of overfished species allocations are significant
Buyers and Processors	The economic effects on buyers and processing companies are uncertain because of the uncertainty as to how well vessel owners within sectors can successfully manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing tactics, processors and buyers would be expected to benefit from higher catches. On the other hand, if an entire fishing sector is shutdown, buyers and processors may experience significant shortages of fish.	Buyers and processors would be expected to benefit from the anticipated increases in fish landings. The overall level of benefits and the distribution of benefits across processors may depend largely on the formula for allocating quota shares. Arguments have been made that harvester-only ITQ programs may result in stranded capital in the processing sector and a shift in the balance of bargaining power toward harvesters. These potential adverse effects could be mitigated if processors were also allocated quota shares.	The net economic effect on buyers and processors is uncertain. In general, buyers and processors would be expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system. The 100% retention requirement could also result in a large increase in landings. However, it is uncertain how much of the additional fish retained would be marketable. Because of their lack of mobility, buyers and processors may be especially negatively affected by marine reserves. However, the effects of marine reserves on specific buyers and processing companies will depend in part on changes in local supply and how processors have adapted to current supply situations.	The economic effects on buyers and processing companies are uncertain because of the uncertainty as to how well vessel owners manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing tactics, processors and buyers would be expected to benefit from higher catches. On the other hand, if an entire fishing sector is shutdown, buyers and processors may experience significant shortages of fish.

Table 4.7.1(b). Summary of effects of Alternatives 4, 5, 6 and 7 on the social and economic environment. (Alternatives 1, 2 and 3 in preceding table).

	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Communities	To the extent that harvesting sectors are not shut down, no significant economic impact on communities is likely. However, if sector closures occurred, there would likely be negative impacts in fishing communities, particularly if processing plants were also closed.	Consolidation of fishing and processing activities to fewer vessels and plants would likely result in reductions in the numbers of crew members and processing workers employed. Granting quota shares to community groups could help maintain existing harvesting and processing patterns and serve to meet concerns about employment in communities.	Effects of a right-based management system as described in Alternative 5. Marine reserves would be expected to help ensure harvests for future generations and the sustained participation of communities in groundfish fisheries. If, however, marine reserves resulted in substantial decreases in groundfish catches over the short term, the economic hardships that fishing families and other members of communities are experiencing under Alternative 1 (no action) would be exacerbated.	To the extent that harvesting sectors are not shut down, no significant economic impact on communities is likely. However, if sector closures occurred, there would likely be negative impacts in fishing communities, particularly if processing plants were also closed.
Consumers	If no early closures of major harvesting sectors occur, the impact on consumers would be expected to be negligible. However, if major fishing sectors were shut down, consumers of fresh or live groundfish could be adversely affected.	Consumers would be expected to benefit from the anticipated increases in fish landings. There is some chance that consumers could be negatively affected, if a rights-based system leads to a decrease in the overall competitiveness of markets for certain groundfish products (e.g., live fish). The likelihood of this occurring would depend both on the level of consolidation that might occur and the elasticity of demand for particular products.	Consumers would benefit from the anticipated increased landings that result from a rights-based system. In addition, over the long term, marine reserves that effectively increase the size and variety of seafood species could make consumers better off. On the other hand, large marine reserves could substantially decrease seafood supply enough to make consumers worse off, at least in the short term. Marine reserves could have a positive effect on those consumers who derive non-consumptive benefits from marine ecosystems, including non-market benefits (e.g., existence value).	If supplies of fish remain consistent, the impact on consumers would be expected to be negligible. However, if major fishing sectors were shut down, consumers of fresh or live groundfish could be adversely affected.
Fishing Vessel Safety	The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations could lead to reductions in injury and loss of life because of harvesters' incentives to maintain equipment, take fewer risks and use their best judgment in times of uncertainty. If fishers within a sector perceive a greater likelihood of premature closure, vessels would likely be more active early in the year (winter	Possible increases in the profitability of harvesting operations would likely lead to reductions in injury and loss of life because of harvesters' incentives to maintain equipment, take fewer risks and use their best judgment in times of uncertainty.	The net effect of the various measures included in this alternative on fishing vessel safety is uncertain. The establishment of ITQs for groundfish species is expected to promote vessel safety by reducing the pressure to fish under dangerous conditions. On the other hand, the establishment of marine reserves may result in a reduction in fishing vessel safety if the closure of fishing grounds results in	The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations could lead to reductions in injury and loss of life because of harvesters' incentives to maintain equipment, take fewer risks and use their best judgment in times of uncertainty. With individual vessel catch limits, some vessels will have more choice of when and where to fish. Winter and early

Table 4.7.1(b). Summary of effects of Alternatives 4, 5, 6 and 7 on the social and economic environment. (Alternatives 1, 2 and 3 in preceding table).

	Alternative 4	Alternative 5	Alternative 6	Alternative 7
	and early spring) when conditions may be more dangerous.		vessels fishing farther from port and possibly in more hazardous areas.	spring fishing may increase if vessels in a sector anticipate premature closures.
Management and Enforcement Costs	Costs would be expected to increase as catch limits were allocated over an increasing number of sectors. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection.	The costs of monitoring, enforcement and administration would be expected to increase significantly. Cost recovery measures such as a fee on quota holders would be expected.	Full (100%) observer coverage would be required, which would facilitate enforcement of a full retention regulation. The enforcement costs of establishing marine reserves vary with several factors, including the location, number, size, and shape of the marine reserves and types of activities restricted and allowed.	Costs would be expected to increase with allocations to multiple sectors. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection.

Table 4.7.2. Significance of indirect effects of the alternatives on the social and economic environment.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Incentives to Reduce Bycatch	S+/S-	I	I	CS+	S+	S+	CS+
Commercial Harvesters	S-	S+	CS+	CS+/CS-	S+/S-	S+/S-	CS+/CS-
Recreational Fishery	S-	I	I	CS-	CS-	S+/S-	CS-
Tribal Fishery	I	I	I	CS-	CS-	CS-	CS-
Buyers and Processors	S-	CS+/CS-	CS+/CS-	CS+/CS-	CS+	CS+/CS-	CS+/CS-
Communities	S-	CS+/CS-	CS+/CS-	CS+/CS-	CS+	CS+/CS-	CS+/CS-
Consumers	I	I	CS-	CS+/CS-	CS+	CS+/CS-	CS+/CS-
Fishing Vessel Safety	CS+/CS-	S+	S+/S-	CS+/CS-	S+	S+/S-	CS+/CS-
Management and Enforcement Costs	S-	S+	CS+/CS-	S-	S-	S-	S-

Significance Ratings:

Significantly Adverse (**S-**): Significant adverse impact based on ample information and the professional judgment of the analysts.

Significantly Beneficial (**S+**): Significant beneficial impact based on ample information and the professional judgment of the analysts.

Conditionally Significant Beneficial (**CS+**)/Conditionally Significant Adverse (**CS-**): Conditionally significant is assigned when there is some information that significant impacts could occur, but the intensity of the impacts and the probability of occurrence are unknown.

Insignificant Impact (**I**): No significant change based on information and the professional judgment of the analysts..

Unknown (**U**): This determination is characterized by the absence of information sufficient to adequately assess the significance of the impacts.

Significantly Beneficial/Significantly Adverse (**S+/S-**): Both significant adverse impacts and significant beneficial impacts are expected to occur. The net effect may be uncertain.

4.8 Cumulative Effects of the Alternatives

Cumulative effects must be considered when evaluating the alternatives to the issues considered in this EIS. Cumulative impacts are those combined effects of an action on the quality of human environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of whether a federal or non-federal agency undertake such actions (40 CFR 1508.7).

Cumulative effects may be either direct or indirect effects of an action on the environment, or some combination thereof. Direct effects of the alternatives include: potential reductions of bycatch and bycatch mortality; increased bycatch accountability; and, improved information about stock removals and stock condition. Indirect effects are related to longer term changes such as changes in species abundance, diversity, and habitat.

Of the past, proposed and foreseeable future actions that are also expected to affect these same waters and fishers, the most notable recent actions were the annual specifications and management measures for the groundfish fisheries in 2003, 2004, and 2005-2006, the passage of eight rebuilding plans for overfished groundfish species (FMP Amendments 16-2 and 16-3), and completion of the trawl buyback program.

For most overfished species, directed harvest has been eliminated. This means that incidental harvest must be reduced for Council actions to reduce total mortality of overfished groundfish species. Incidental take of overfished groundfish species has been reduced through gear regulations, seasonal restrictions, and area closures. The Council has used its 2003, 2004 and 2005-2006 specifications and management measures processes to develop and implement these protective regulations. In 2003, the Council introduced the RCAs, large coastwide area closures intended to protect overfished groundfish from fishing activities in areas where they commonly congregate. In 2004, NOAA Fisheries implemented a requirement for all limited entry vessels to carry and use VMS units in order to better enforce area closures. The Council is contemplating expanding this requirement to the open access fisheries and other sectors. All of the alternatives in this EIS would continue the use of closed areas for groundfish management. Under these alternatives, GCAs would continue to be used to reduce bycatch of overfished species. The EFH EIS, now under development, is considering the FMP's long term goals for habitat management and area closures. Under that EIS, the Council will consider area closures as management tools to address a range of issues, not just bycatch reduction. The effects of the 2003, 2004, and 2005-2006 groundfish specifications and management measures, including cumulative impacts, have been described and analyzed in EISs prepared by the Pacific Council. VMS alternatives and cumulative impacts are described in the EA/RIR for *A Program to Monitor Time-Area Closures in the Pacific Coast Groundfish Fishery* (PFMC, 2003e).

In 2003, NOAA Fisheries implemented a trawl permit buyback program, reducing the number of limited entry trawlers by 35%. Several of the alternatives to this EIS contemplate further capacity reduction. The Council is also in the process of considering

a dedicated access privileges program for the limited entry trawl fishery. Vessel owners with dedicated access privileges are better able to plan for and invest in their future, including optimizing their product marketing opportunities. Implementing a dedicated access privilege program in the trawl fishery would improve the financial standing of the fishery's participants, making bycatch monitoring devices and personnel a more easily borne vessel cost. Effort reduction could reduce the impacts of fishing on the environment in the long run. However, the trip limit management program has prevented many commercial fishing vessels from operating near their harvest capacity. Even with a smaller fleet, restrictions will be necessary to prevent vessels from increasing their efficiency and fishing power. Bycatch mitigation tools, such as individual fishing quotas can exert a powerful influence on harvest capacity by changing the basic incentive structure of the industry. Over time, such rights-based programs can substantially reduce effort levels and better respond to natural population fluctuations.

Alternatives considered in this EIS incorporate many bycatch mitigation tools and other measures currently used to manage the groundfish fishery. Depth-based and marine protected areas, coupled with effort reduction, are among the mitigation tools that reduce bycatch and bycatch mortality. Measures that increase accountability and recording of all catch will also help mitigate the effects of bycatch.

The area that would be affected by actions discussed in this document is the Pacific Coast Groundfish Fishery in the EEZ (3 to 200 nautical miles offshore). External factors dominating the Pacific Coast groundfish fishery[13/] include meso-scale climate events and climate changes such as the El Niño and La Niña events, coupled with longer term Pacific Decadal Oscillation regime shifts. These factors drive much of the productivity of resources within the management area. Factors related to ecosystem structure also may influence cumulative effects. For example, past fishing activities (both for groundfish and other marine fishes) have altered species composition and abundance of many species. This is most apparent with respect to the eight overfished groundfish species. Rebuilding plans and bycatch alternatives that seek to conserve and restore these rockfish to their former abundance will have significant beneficial impacts on these and other marine animals. However, because marine food webs have multiple competitors in each trophic level, some species may be unsuccessful in regaining their previous dominance, especially if their niche has been colonized by a productive and successful competitor.

Tables 4.8(a) and 4.8(b) summarize cumulative effects of the proposed action and alternatives.

4.8.1 Cumulative Effects on the Marine Ecosystem, Habitat, and Biodiversity

When combined with the external factors identified above, most of the alternatives are

13/ These have been described in the 2004 Groundfish Annual Specifications EIS (PFMC, 2003e), which is incorporated by reference.

likely to have modest but probably indistinguishable effects on the marine ecosystem, habitat, and biodiversity. Alternative 6 would establish long-term no-take marine reserves which would be closed to most or all groundfish fishing. Elimination of such human disturbances may result in both anticipated and unexpected changes to the ecosystem: certain habitats would be expected to return to a more natural state, and biodiversity would likely increase within these areas. The degree of change would be expected to be proportional to the size of the closed areas. The greatest effects would be expected with stationary and relatively immobile benthic species that would typically flourish in the habitats protected by such reserves. Because this alternative would affect only groundfish fishing activities, habitat impacts from non-groundfish fisheries could continue to occur within the closed areas.

4.8.2 Cumulative Effects on Groundfish

As was noted in the 2004 Groundfish Annual Specifications EIS (PFMC, 2003e), overfished stock status is a cumulative effect, since it results from past over fishing that reduced the stock size. Under Alternative 1, management measures including those used to address bycatch issues have not always been successful in keeping catches from exceeding sustainable levels. In the case of overfished species such as canary rockfish, the result is severely depleted stock status for several decades to come. Alternatives 2 and 3 could also fail to achieve the rebuilding objectives and result in delayed rebuilding. However, the Council now practices more risk-averse, adaptive management of groundfish. Thus, cumulative impacts are expected to be mitigated compared to what would have been predicted even a few years ago.

Alternatives 4, 5, 6 and 7 complement rebuilding efforts by better accounting for and reducing bycatch and bycatch mortality. They would accomplish this through catch caps and increased monitoring. Cumulative adverse effects of fishing and bycatch would tend to diminish for overfished and healthy stocks of groundfish in proportion to effort reduction. Under Alternative 6 and perhaps Alternative 4-7, long-term protected areas may result in increased species diversity and an increase in average size of groundfish within the protected areas.

4.8.3 Cumulative Effects on Protected Species

Cumulative effects generally correlate with direct and indirect effects and external environmental factors. Alternatives that result in reduced fishing effort would result in smaller adverse cumulative effects on halibut, salmon, seabirds, and marine mammals (Alternatives 2, 5, and 6). These effects would likely be insignificant across all alternatives, because impacts are considered low under the no action alternative, Alternative 1. Cumulative impacts of Alternative 3 are more difficult to predict, because the timing of seasonal openings and closures may influence interactions with protected species.

4.8.4 Cumulative Effects on Groundfish Fisheries

Alternative 1 is likely to have generally adverse cumulative effects. Efforts to rebuild some overfished species may not be successful under the no action alternative. Additional restrictive management measures may result in reduced future harvest opportunities for healthy stocks or a concentration of effort outside of closed areas or within shorter time periods. Discard/bycatch rates may increase as a result of increased competition during open periods and areas. Accountability would be lower than other alternatives, resulting in greater uncertainty. The cumulative effects of increased regulation, lower fishery yields, uncertainty, and disruption of fishing patterns would be anticipated to be adverse and significant. Alternative 3, and to a lesser extent Alternative 4, has the potential to create a race for fish due to a shortened season. Thus, Alternative 3 may also result in adverse cumulative effects on the fishery if shortening the season failed to increase trip limits or reduce bycatch.

Alternatives 2, 4, 5, 6, and 7 should have beneficial incremental effects when combined with other management alternatives supportive of rebuilding overfished stocks. Alternatives 4, 5, 6 and 7 have beneficial cumulative effects in reducing bycatch, bycatch mortality, and increasing accountability. These results are likely to have a long-term beneficial effect if stocks return to levels capable of producing higher sustainable harvests. Trawl fleet capacity would be reduced under Alternative 2; even greater consolidation would be expected under Alternatives 5 and 6. Under Alternative 2, latent effort could lead to increased harvest rates in spite of fleet reduction. Additional restrictive management measures may still be required to maintain rebuilding. Alternatives 5 and 6 have the greatest potential to reduce latent capacity, followed by Alternative 7. Over the long-run, this would result in reductions in latent effort, healthier stocks, and a reduced need for additional restrictive management measures.

4.8.5 Cumulative Effects on Safety

VMS, used to increase accountability, should make fishing vessels inherently easier to locate, and therefore safer if the vessel and crew are in jeopardy. Various kinds of area closures used in the all of the alternatives may cause vessels to fish further off shore and may increase risk. There may be a significant positive cumulative benefit and increased fleet safety for those alternatives that reduce effort (Alternatives 2, 5, and 6) or establish transferable catch quotas (Alternatives 5 and 6) because these bycatch reduction tools would tend to reduce the race for fish. Alternatives 4 and 7 provide a mechanism for greatly reducing inter-sector competition, and intra-sector competition in the form of individual vessel catch limits.

Table 4.8(a). Summary of direct, indirect and cumulative effects of Alternatives 1, 2 and 3.

Resource Issue or Category	Alternative 1	Alternative 2	Alternative 3
Habitat: Trawl and other gear contacting the bottom damage benthic organisms and physical structure			
Direct/Indirect	No change from baseline	No change from baseline	No change from baseline
Cumulative	No change from baseline	No change from baseline	No change from baseline
Ecosystem/Biodiversity: Lowered abundance of particular species changes ecosystem structure, stock declines lead to local/regional extinction.			
Direct/Indirect	No change from baseline	No change from baseline	No change from baseline
Cumulative	No change from baseline	No change from baseline	No change from baseline
Groundfish: Bycatch and bycatch mortality of overfished and other groundfish			
Direct/Indirect	Catch rates of overfished species such as canary and bocaccio rockfish may delay or prevent rebuilding. Discard/bycatch of other groundfish could remain high due to constraints for overfished species.	Reduced fishing effort expected to reduce bycatch and bycatch mortality of overfished and other groundfish. Latent capacity remains and could negate any savings.	Effects may be similar to Alternative 1 if shortened season does not result in larger trip limits.
Cumulative	Canary and bocaccio rockfish may not be sustainable.	Higher probability of rebuilding overfished species. Reduced bycatch and bycatch mortality of other groundfish may allow fuller resource utilization but not necessarily increased abundance.	Effects may be similar to Alternative 1 if shortened season does not result in larger trip limits.
Protected species: Bycatch and bycatch mortality of Pacific halibut, Pacific salmon, marine birds and mammals.			
Direct/Indirect	No change from baseline	No change from baseline	Interactions are thought to be low, but may be completely absent during seasonal closures. Halibut bycatch depends on timing of seasonal closures.
Cumulative	No change from baseline	No change from baseline	Interactions with birds depend on timing of seasonal closures.

Table 4.8(a). Summary of direct, indirect and cumulative effects of Alternatives 1, 2 and 3.

Resource Issue or Category	Alternative 1	Alternative 2	Alternative 3
Accountability: Increased monitoring bycatch and bycatch mortality improves accountability.			
Direct/Indirect	Provides for statistically reliable measures of bycatch on an annual basis, but not inseason.	Marginal improvement in monitoring coverage of trips.	Marginal improvement in monitoring coverage of trips
Cumulative	Lack of timely inseason data may lead to unsustainable fisheries for some overfished species.	Similar to Alternative 1 - data cannot be used in-season.	Similar to Alternative 1 - data cannot be used in-season

Table 4.8(b). Summary of direct, indirect and cumulative effects of Alternatives 4, 5, 6and 7 for West Coast groundfish fisheries.

Resource Issue or Category	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Habitat: Trawl and other gear contacting the bottom damage benthic organisms and physical structure				
Direct/Indirect	No change from baseline	Reduction in closed areas	Reduction in closed areas	No change from baseline
Cumulative	No change from baseline	Increased growth of living benthic habitat (sponges and corals) in closed areas.	Increased growth of living benthic habitat (sponges and corals) in closed areas.	No change from baseline
Ecosystem/Biodiversity: Lowered abundance of particular species changes ecosystem structure, stock declines lead to local/regional extinction.				
Direct/Indirect	No change from baseline	Increased growth and abundance of some species in closed areas	Increased growth and abundance of some species in closed areas	No change from baseline
Cumulative	No change from baseline	Increased biodiversity in closed areas	Increased biodiversity in closed areas	No change from baseline
Groundfish: Bycatch and bycatch mortality of overfished and other groundfish				
Direct/Indirect	Reduces bycatch and bycatch mortality of overfished species in particular - due to RSQ caps for overfished species.	Reduces bycatch and bycatch mortality of overfished and other groundfish through use of MPAs, RSQs and IFQs for overfished and other groundfish.	Reduces bycatch and bycatch mortality of all groundfish through use of no-take reserves, RSQs, IFQs, and 100% groundfish retention requirement.	Reduces bycatch and bycatch mortality of overfished species in particular - due to sector allocations and vessel catch limits for overfished species.
Cumulative	Higher likelihood and rate of rebuilding, with possible exception of bocaccio rockfish.	Higher likelihood and rate of rebuilding of overfished groundfish, possible increases in other groundfish populations.	Highest likelihood and rate of rebuilding of overfished groundfish. Increased size and diversity of groundfish within closed areas.	Higher likelihood and rate of rebuilding, with possible exception of bocaccio rockfish.

Table 4.8(b). Summary of direct, indirect and cumulative effects of Alternatives 4, 5, 6and 7 for West Coast groundfish fisheries.

Resource Issue or Category	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Protected species: Bycatch and bycatch mortality of Pacific halibut, Pacific salmon, marine birds and mammals.				
Direct/Indirect	No change from baseline.	Small reductions in bycatch and bycatch mortality within protected areas.	Small reductions in bycatch and bycatch mortality within protected areas.	No change from baseline.
Cumulative	No change from baseline.	No change from baseline.	No change from baseline.	No change from baseline.
Accountability: Increased monitoring bycatch and bycatch mortality improves accountability.				
Direct/Indirect	Significantly improved monitoring coverage. In-season data can be used to make in-season adjustments. Accurate in-season accounting of overfished stocks of groundfish.	Significantly improved monitoring coverage with 100% observer coverage of commercial fleet. Real-time accounting of groundfish. Discard/ bycatch of overfished groundfish nearly eliminated.	Significantly improved monitoring coverage with 100% observer coverage of commercial fleet. Real-time accounting of all groundfish catch. No groundfish discard/bycatch.	Significantly improved monitoring coverage. Over time, catch and bycatch data would be available inseason for management of overfished stocks of groundfish and other species.
Cumulative	Reduced risk and higher likelihood of rebuilding overfished stocks of groundfish.	Reduced risk and higher likelihood of rebuilding overfished groundfish stocks.	Reduced risk and higher likelihood of rebuilding overfished groundfish stocks.	Reduced risk and higher likelihood of rebuilding overfished stocks of groundfish.

4.9 Practicability

4.9.1 Background

The Magnuson-Stevens Act's National Standard 9 states that "[c]onservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch." 16 U.S.C. 1851(a)(9). The National Standard Guidelines implementing National Standard 9 state that "[a] determination of whether a conservation and management measure minimizes bycatch or bycatch mortality to the extent practicable, consistent with the other national standards and maximization of net benefits to the Nation, should consider the following factors:

(A) Population effects for the bycatch species.
(B) Ecological effects due to changes in the bycatch of that species (effects on other species in the ecosystem).
(C) Changes in the bycatch of other species of fish and the resulting population and ecosystem effects.
(D) Effects on marine mammals and birds.
(E) Changes in fishing, processing, disposal, and marketing costs.
(F) Changes in fishing practices and behavior of fishermen.
(G) Changes in research, administration, and enforcement costs and management effectiveness.
(H) Changes in the economic, social, or cultural value of fishing activities and non-consumptive uses of fishery resources.
(I) Changes in the distribution of benefits and costs.
(J) Social effects."

50 C.F.R. 600.350(d)(3).

The meaning of "practicable" as the term is used in National Standard 9 was recently discussed in Conservation Law Foundation v. Evans, 360 F.3d 21, 27-28 (1st Cir. 2004). In that case, the court stated:

> Moreover, the plaintiffs essentially call for an interpretation of the statute that equates "practicability" with "possibility," requiring NMFS to implement virtually any measure that addresses EFH and bycatch concerns so long as it is feasible. Although the distinction between the two may sometimes be fine, there is indeed a distinction. The closer one gets to the plaintiffs' interpretation, the less weighing and balancing is permitted. We think by using the term "practicable" Congress intended rather to allow for the application of agency expertise and discretion in determining how best to manage fishery resources.

Taking into account the considerations described above, all of the alternatives analyzed in this EIS are possible to implement, to varying degrees. Some alternatives are more or less practicable to implement, depending on the perspective from which practicability is considered. Alternative 7 (preferred) is one of the most practicable alternatives from a variety of perspectives and when considering both near- and longer-term practicability.

4.9.2 Population and Ecosystem Effects

In recent years, West Coast groundfish management has been primarily concerned with, and driven by, the need to rebuild the eight overfished groundfish species. The FMP and its implementing regulations must continue to meet the overfished species rebuilding requirements of the Magnuson-Stevens Act. Thus, any bycatch mitigation program must foster the rebuilding of overfished species. Although Alternative 1 (status quo) meets overfished species rebuilding requirements, other alternatives would provide even better protection for overfished species. All of the alternatives to status quo would either reduce capacity, reduce an individual vessel's fishing time, or require greater individual vessel total catch accountability. These alternatives would also have the effect of increasing the amount of available total catch data, and improving information used for inseason catch monitoring and for stock assessments. More and better information about overfished species would allow the agency to better track its achievement of rebuilding plan goals, and better meet the agency's long-term goals for gathering data on and protecting a broad range of marine species. More and better information about non-groundfish species taken incidentally in the groundfish fisheries, including data on structure-forming invertebrates and other non-commercial species, would allow the agency to better characterize and monitor the West Coast ecosystem as a whole.

4.9.3 Social effects as costs to the fishing industry, and changes in fishing practices and behavior of fishermen

The cost of bycatch management program is of great importance to participants in the West Coast groundfish fisheries, who have seen the value of their groundfish landings (commercial) and charter trip sales (recreational) decline notably in recent years.

For fishing communities and the fishing industry, practicability of a bycatch management program may be assessed in terms of: whether it allows community members to make longer-term business plans; whether the cost of the program to fishery participants is prohibitive when compared against profits from that fishery; whether it encourages fishery participants to innovate with respect to bycatch mitigation measures; whether regulations are easy to understand and apply; and whether fishers and processors are required to keep fish that they cannot sell. Alternative 1 (status quo) is less practicable than other alternatives in terms of providing a stable business-planning environment. Groundfish fisheries management in recent years has become increasingly more restrictive and complex, with much seasonal and year-to-year variation in available catch

of different species. None of the alternatives could be expected to reduce natural year-to-year or decade-to-decade variations in available catch. However, Alternatives 5-7 would provide fishery participants with greater control over their own fishing activities. These alternatives include dedicated access privilege programs that would move more of the decisions on when and where to fish which species away from governmental agencies and to individual fishery participants.

Alternative 4 may be the least practicable alternative in terms of its cost to fishery participants, because it would require high levels of per vessel monitoring without increasing per vessel profits through a capacity reduction program. Alternatives 2 and 5-7 would each include some measure of capacity reduction, and Alternatives 5-7 would include increased monitoring levels, the cost for which could be somewhat recouped by increased fishing opportunities. Alternative 3 would be less practicable than the other alternatives when considering both longer-term planning and program costs because it would allow each vessel to fish only six months of the year, which would reduce the vessel operator's flexibility to fish in ways that improve the likelihood of recouping program costs.

NOAA Fisheries and West Coast states currently encourage innovations in bycatch-reducing gear designs through EFPs and research programs. However, the current management program provides fewer gear experimentation incentives than Alternatives 4-7. Those alternatives implement sector/vessel bycatch caps and/or dedicated access privilege programs. Both of these programs give vessel operators more incentive to improve their individual vessel's bycatch reduction performance. Gear modifications have often proven useful in reducing bycatch. However, an individual skipper's ability to use that gear appropriately, or conduct fishing operations in certain areas or weather, may have a greater influence on the vessel's ability to reduce its bycatch. Alternatives 1-3 provide fewer of these individual incentives for fishery participants to think creatively about how to increase their vessel profits through reducing bycatch.

Current groundfish regulations (Alternative 1) are already quite complex. Seasons, trip limits, and area closures vary along the length of the coast. Alternative 2 would likely be similar to Alternative 1 in terms of regulatory complexity, although those regulations would have to be understood by fewer people. Alternatives 3-7 would increase regulatory complexity overall, although regulatory complexity would likely be reduced for some sectors within the fishery. Complex regulations governing the use and transfer of individual vessel quotas would replace complex trip limit and season regulations. Alternative 6 may have the least regulatory complexity because it would require long-term, fixed-boundary closed areas.

Under the Magnuson-Stevens Act, the amount of fish that is dumped overboard is considered bycatch and that amount must be reduced to the extent practicable. One simple way of reducing the amount of fish that is dumped overboard it to require vessels

to land all of their catch. For some fishery sectors, such a requirement would simply transfer the discarded biomass from sea to land. NOAA Fisheries can require vessels to bring in all of their catch, but it cannot require markets to accept all of the species landed. The best way to prevent fishers and processors from having to keep fish they cannot use may be to give them the flexibility to avoid bycatch of species they cannot use, and to create new markets for species they normally catch but have not historically used. As stated above, Alternatives 4-7 would provide fishers greater incentives to change their fishing practices to reduce bycatch and Alternatives 5-7 would provide the greatest flexibility for business planning by individual fishery participants.

4.9.4 Social effects as costs to non-consumptive users of fishery resources

For non-consumptive users of fishery resources, the practicability of a bycatch management program may be assessed in terms of: whether these users may have longer-term expectations that marine species' populations will continue to be healthy and productive (existence and bequeathal values); whether a portion of the marine ecosystem is set aside from consumptive use because of its intrinsic and/or educational values; whether the action may be expected to result in increasing or decreasing biodiversity, based on the assumption that higher biodiversity represents a more sophisticated and more healthy marine ecosystem. Alternative 1 is less practicable than the other alternatives because it does not make any longer-term plans for bycatch reduction and management, simply expecting that bycatch reduction will occur through overfished species rebuilding programs. All of the alternatives to status quo could be expected to be more practicable in terms of rebuilding and maintaining healthy populations of marine species. Alternatives 4-7 are expected to have greater bycatch and capacity reduction effects than Alternatives 1-3, and thus are more practicable for maintaining healthy and productive marine species populations. Alternative 6 combines marine area closures to groundfish fishing with capacity reduction, thus may be the most practicable alternative for longer-term maintenance of healthy marine species populations, groundfish and non-groundfish. The Council's preferred alternative, Alternative 7, combines capacity reduction with sector-specific management and ongoing use of RCAs for the protection of overfished groundfish. Thus, Alternative 7 is practicable in terms of maintaining groundfish stocks, but relies on incidental benefits to protect non-groundfish species other than those specifically targeted for protection such as halibut, salmon, seabirds, and marine mammals.

None of the alternatives set aside any species or areas from all consumptive use. Alternative 6, however, would set aside large areas from consumptive use of groundfish and from impacts of groundfish fishing gear on habitat within those areas. Under the current FMP, cowcod is set aside from consumptive use. None of the alternatives would alter the FMP's protection for cowcod. NOAA Fisheries will be considering action alternatives within its EFH EIS that would set aside ocean areas from all consumptive use, a draft of which is scheduled for completion in February 2005.

All of the alternatives to status quo may be expected to reduce the overall level of dead discards in the fishery relative to status quo. Some of the alternatives, such as Alternatives 4-7, provide greater incentives for fishery participants to be innovative in designing bycatch-reducing gear. If undesired or illegal species are less frequently caught because of better gear design, then more live biomass remains in the marine environment, ultimately improving the health and biodiversity of the marine ecosystem. Some bycatch management programs simply require retention of all that is caught. If a full-retention program is applied or monitored inappropriately, dead marine biomass may be removed from the marine ecosystem and disposed of on land, ultimately harming the health and biodiversity of the marine ecosystem. Given this potential challenge, Alternative 7 is more practicable than Alternatives 4 and 5, because it requires a closer look at fishery-specific management to determine which bycatch reductions tools are most appropriate for different sectors of the fishery.

4.9.5 Management Costs and Effectiveness

In addition to being a concern to fishermen, bycatch program costs are also an important consideration for federal and state agencies with pessimistic outlooks for near-future fisheries management budgets. The fishery management agencies are also concerned that costs of micro-managing the fishery to minimize and avoid bycatch could overwhelm the economic benefits from the fishery. Two management reponsibilities that pose significant cost and effectiveness concerns are enforcement, and data gathering and analysis.

Different alternatives are more or less enforceable depending on their complexity and/or the technological requirements for their enforcement. Enforcement of West Coast groundfish fisheries regulations became notably more complex when the Council and NOAA Fisheries introduced the coastwide Groundfish Conservation Areas in 2003. To improve area closure enforcement, NOAA Fisheries implemented a VMS program on January 1, 2004. Alternatives 1-3 and 6 would all continue to include area closures, although those closures would have less complex boundaries under Alternative 6. Alternatives 4, 5, and 7 could include closed areas for bycatch mitigation, but could also provide vessels with enough incentives to reduce individual vessel bycatch such that closed areas for bycatch mitigation would become unnecessary. Tracking of catch and landings limits would continue to be complex under all alternatives. Alternatives 4-7 would likely require increased enforcement presence and technological improvements in catch and landings tracking systems over Alternatives 1-3. Because new technologies may need to be researched and introduced, Alternatives 4-7 are also not as immediately practicable as Alternatives 1-3. This should not be taken to mean that they are necessarily less practicable over the longer-term.

With respect to data gathering and analysis, each of the different alternatives requires different levels of scientific information to implement. Some alternatives are more

practicable in terms of available scientific information because they do not require additional science program expenses beyond those already expected to be committed for the near-term. Alternative 1 (status quo) is practicable from this perspective, as it would simply continue our current science and management programs. Some alternatives are less practicable because they would require notable new science time and effort to implement. Alternatives 4-7 are less practicable from this perspective because they would require splitting the groundfish fleets into ever-smaller units, which would likely require historical catch analyses for fleets or individuals. For some fisheries or individuals, historic catch data may either not exist or may not be in an appropriate format for use in the desired management program. (For example, one of the challenges of implementing the limited entry program was accurately attributing gear-specific catch to vessels from historic fish tickets that did not specify certain gear types.) Some bycatch minimization goals may also be impracticable. For species that occur infrequently, such as cowcod and yelloweye rockfish, it is often not possible to attain highly precise estimates of bycatch rates given the relatively large quantity of groundfish observed in total catch monitoring programs like WCGOP.

Alternative 7, the Council's preferred alternative, calls for the use of sector catch cap and dedicated access privilege programs where practicable. This alternative would require the evaluation of individual sectors for practicability of bycatch program application. Thus, it would encourage near-term implementation of those measures most scientifically practicable given our current information. Alternative 7 would also encourage regular re-consideration by the Council of what is practicable, such that as new bycatch mitigation programs would continue to be implemented as new scientific information becomes available. None of the alternatives would have any effect on funding for NOAA Fisheries and West Coast state scientific programs. Even if more data is gathered under Alternative 7, participating agencies may not have the funding to process and analyze that data.

4.9.6 Conclusion

The Council's preferred alternative, Alternative 7, reduces bycatch to the extent practicable from a variety of perspectives. It encourages fisher innovation, uses capacity reduction to reduce the overall effect of fisheries on the marine environment, and would improve the quantity and quality of scientific data gathered on marine species. The Council is scheduled to begin an FMP amendment to implement Alternative 7 at its November 2004 meeting. The amendatory language will provide guidance on future sector cap and full retention programs, and on designing dedicated access privilege programs so that they achieve bycatch reduction. This guidance should be useful to the Council as it develops its first IFQ program, for the limited entry trawl fisheries. The Council is also scheduled to finalize a full retention program for the shorebased Pacific whiting fishery, which was developed with the principles discussed in this EIS in mind. At its September and November 2004 meetings, the Council is scheduled to consider a

VMS requirement for the open access groundfish fisheries. Implementing that requirement for the open access fisheries would provide fisheries managers a more clear and consistent picture of which vessels are participating in the open access. With improved participant information, the Council will be better able to consider which sectors of the open access fishery may be appropriate for capacity reduction, full retention, or sector bycatch cap programs.

In addition to the programs growing out of this EIS, the Council has just completed Amendments 16-2 and 16-3 to the FMP. These amendments incorporated eight overfished species rebuilding plans into the FMP and reaffirmed the FMP's focus on rebuilding overfished species as the driving policy behind many of its groundfish management programs. Further, NOAA Fisheries will be bringing draft alternative for its EFH EIS before the Council at its September meeting. The agency expects that the FMP amendment that develops from this EFH EIS will set new groundfish habitat management and protection protocols. Together, these three management foci – bycatch reduction, overfished species rebuilding, and habitat protection – form the basis for the Council's current and future groundfish management program.

4.10 References (Biological Sections)

Berry, M. D. (Inner Coast Natural Resource Centre). 2001. Area 12 (Inside) rockfish selective
fishery study. Fisheries Renewal BC and Science Council of BC, Alert Bay, BC, June 26, 2001.

Clark, W.G. and G. H. Williams. 2001. History of Area 2 fisheries, management and assessments. Pages 91-102 *in* IPHC Report of Assessment and Research Activities 2001. International Pacific Halibut Commission, Seattle, WA.

Davis, M. W., and C. H. Ryer 2003. Understanding fish bycatch discard and escapee mortality. NMFS Alaska Fisheries Science Center, AFSC Quarterly Rept.

Hannah, R. W. 2003. Spatial changes in trawl fishing effort in response to footrope diameter restrictions in the U.S. West Coast bottom trawl fishery. North American Journal of Fisheries Management 23:694-703.

Hannah, R. W. (Oregon Dept. of Fish and Wildlife). 2003b. J. T. Golden, Newport, OR: Evaluation of fish excluder technology to reduce finfish bycatch in the ocean shrimp trawl fishery

Hannah, R. W., S. A. Jones, and V. J. Hoover 1996. Evaluation of fish excluder technology to reduce finfish bycatch in the ocean shrimp trawl fishery. Oregon Dept. of Fish and Wildlife, Newport, OR, Information Report 96-4.

Hastie, J. 2003. Discussion of bycatch modeling methods for evaluating management measures for the 2002 and 2003 groundfish trawl fisheries; Prepared for the PFMC's Bycatch Model Review Panel. Pacific Fishery Management Council, Portland, OR, Unpublished report available from the Council office.

Hilborn, R., J. Skalski, A. Anganuzzi, and A. Hoffmann. 1995. Movements of Juvenile Halibut in IPHC Regulatory Areas 2 and 3. International Pacific Halibut Commission, Seattle, WA. Tech. Rep. 31, 44 p.

IPHC. 1998. The Pacific Halibut: Biology, Fishery and Management. International Pacific Halibut Commission, Seattle, WA. Tech. Rep. 40, 63 p.

Larkin, M., D. Lowman, B. Pettinger, J. Thomas, and R. Young 2003. The British Columbia individual vessel quota experience: lessons for the West Coast trawl groundfish fishery, report on June 24, 2003 meeting. Pacific Fishery Management Council, Portland, OR, September 2003, Attachment C.10.b.

Matteson, K., R. W. Hannah, and J. T. Golden 2001. Evaluation of pot and longline gear as survey tools for sablefish. Oregon Dept. of Fish and Wildlife, Newport, OR, January 2001, Information Report No. 2001-03.

Methot, R., T. Hesler, and J. Hastie 2000. A preliminary analysis of discarding in the 1995-1999 West Coast groundfish fishery, Seattle, Washington, Unpublished manuscript.

NMFS (National Marine Fisheries Service). 2003. Northwest Fisheries Science Center West Coast groundfish observer program initial data report and summary analyses. NMFS, Northwest Fisheries Science Center, Seattle, WA, January 2003.

Parker, S. J. (Oregon Dept. of Fish and Wildlife). 2003. Preliminary results J. T. Golden, Newport, Oregon: ODFW Selective Flatfish Trawl. August 19, 2003.

Parker, S. J., P. S. Rankin, R. W. Hannah, and C. B. Schreck. 2003. Discard mortality of trawl-caught lingcod in relation to tow duration and time on deck. North American Journal of Fisheries Management 23:530-542.

PFMC (Pacific Fishery Management Council). 2001. Marine reserves to supplement management of West Coast groundfish resources. Phase I technical analysis. Pacific Fishery Management Council, Portland, Oregon.

PFMC (Pacific Fishery Management Council). 2003a. Bycatch model review workshop. Final Report. Pacific Fishery Management Council, Portland, Oregon, January 27-29, 2003.

PFMC (Pacific Fishery Management Council). 2003b. Final environmental impact statement for the proposed groundfish acceptable biological catch and optimum yield specifications and management measures 2003 Pacific Coast groundfish fishery, Portland, Oregon.

PFMC (Pacific Fishery Management Council). 2003c. Draft Amendment 16-2: Rebuilding plans for darkblotched rockfish, Pacific Ocean perch, canary rockfish, and lingcod. Pacific Fishery Management Council, Portland, Oregon, June 2003.

PFMC (Pacific Fishery Management Council). 2003d. Proposed groundfish acceptable biological catch and optimum yield specifications and management measures 2004 Pacific Coast groundfish fishery, Portland, OR.

PFMC (Pacific Fishery Management Council). 2003e. Draft environmental assessment/regulatory impact review/regulatory flexibility analysis for a program to monitor time-area closures in the Pacific Coast groundfish fishery. Prepared by

NOAA Marine Fisheries Service, Seattle, WA, January 2003, Exhibit B.9 Attachment 1 presented at the June 2003 Council meeting.

PFMC (Pacific Fishery Management Council). 2003f. Review of 2002 Ocean Salmon Fisheries, Portland, OR.

PFMC (Pacific Fishery Management Council). In prep. Draft Environmental Assessment for Amendment #10 to the Pacific Coast Groundfish FMP, September 2003, Portland, OR.

PFMC. Unpublished **(?)** Estimates of Pacific Halibut Bycatch and Mortality in IPHC Area 2A in 1998, 1999 and early 2000. October 31, 2000 draft. Pacific Fishery Management Council, Portland, OR. 9 p.

Pikitch, E. K., D. L. Erickson, and J. R. Wallace 1988. An evaluation of the effectiveness of trip limits as a management tool. Fisheries Research Institute, School of Fisheries, Univ. of Wash., Seattle, WA, November, 1988, NWAFC Processed Report 88-27.

Rankin, P. S. 2003. J. T. Golden, Newport, Oregon: Personnel Communication. August 19, 2003.

Richardson, B., and V. O'Connell 2002. The southeast Alaska northern southeast inside sablefish fishery information report with outlook to the 2002 fishery. Alaska Dept. of Fish and Game, Juneau, AK, Regional Information Report No. 1J02-34.

Saelens, M., and C. Creech (Oregon Dept. of Fish and Wildlife). 2003. Raw data summary by J. T. Golden using EDCP database J. T. Golden, Newport, Oregon: Oregon Enhanced Data Collection Program. September 19, 2003.

Sampson, D. B., and E. M. Stewart. 1993. An assessment of the English sole stock off Oregon and Washington. Appendix H-1 to status of the Pacific coast groundfish fishery through 1993 and recommended acceptable biological catches for 1994 (SAFE Report). Pacific Fishery Management Council, Portland, OR.

Sampson, D. B., and C. Wood 2002. Stock status of Dover sole off the U.S. West Coast in 2000. Pacific Fishery Management Council, Portland, OR.

TenEyck, N., and R. Demory 1975. Utilization of flatfish caught by Oregon trawlers in 1974. Oregon Dept. of Fish and Wildlife, August, 1975, Information Rept. 75-3.

Walters, C. J., and R. Bonfil. 1999. Multispecies spatial assessment models for the British Columbia groundfish trawl fishery. Can. J. Fish. Aquat. Sci. 56:601-628.

Wiedoff, B., J. Conrad, and S. Parker. 2003. Shoreside Hake Observation Program: 2003. Oregon Dept. of Fish and Wildlife, Portland, OR. Accessed on Aug. 18, 2003 at http://hmsc.oregonstate.edu/odfw/finfish/wh/index.html.

4.10 References (Economic Sections)

Anderson, L.G. 1992. Consideration of the Potential Use of Individual Transferable Quotas in U.S. Fisheries. Volume 1. Overview Document. NOAA Contract No. 40AANF101849.

Alverson, D.L., M.H. Freeberg, S.A Murawski, and J.G. Pope. 1994. A Global Assessment of Fisheries Bycatch and Discards. FAO Fisheries Technical Paper No. 339, Food and Agriculture Organization of the United Nations, Rome.

Arnason, R. 1993. Icelandic fisheries management. *In* The Use of Individual Quotas in Fisheries Management, Organisation for Economic Co-operation and Development, Paris.

Baulch, K. and S. Pascoe. 1992. Bycatch Management Options in the South East Fishery. ABARE Research Report 92.18, ABARE, Canberra.

Bristol Bay Economic Development Corporation (BBEDC). 2003. Bristol Bay Salmon Fishery Restructuring Study. Dillingham, AK.

Callicott, J. 1986. On the intrinsic value of nonhuman species. In B. Norton (ed.), The Preservation of Species: The Value of Biological Diversity. Princeton University Press, Princeton.

Carter, D. 2003. Protected areas in marine resource management: another look at the economics and research issues. Ocean and Coastal Management 46(5):439-456.

Chambers, S. 2002. West Coast Choices: Fishing Uncertain Future. The Worldlink.com. Online: www.theworldlink.com/access/wcchoices/index.shtml

Clucas, I. 1997. A Study of the Options for Utilization of Bycatch and Discards from Marine Capture Fisheries. FAO Fisheries Circular No. 928 FIIU/C928, Food and Agriculture Organization of the United Nations, Rome.

Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. O'Neil, J. Paruelo, R. Raskin, P. Sutton and M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. Nature 387:253-260.

Crutchfield, J. 1979. Economic and social implications of the main policy alternatives for controlling fishing effort. Journal of the Fisheries Research Board of Canada 36:742-752.

Dugan, J. E., and G. E. Davis. 1993. Applications of marine refugia to coastal fisheries management. Canadian Journal of Fisheries and Aquatic Sciences 50:2029-2042.

Dewees, C.M. and E. Ueber (eds.). 1990. Effects of Different Fishery Management Schemes on Bycatch, Joint Catch, and Discards. California Sea Grant College, University of California, La Jolla, California.

Furness, R. 1999. Will reduced discarding help or harm seabird populations? *In* Alaska Sea Grant College Program (ed.), Ecosystem Approaches for Fisheries Management. Alaska Sea Grant College Program Report AK-SG-99-01, University of Alaska Fairbanks, Fairbanks.

Geen, G., Nielander, W. and T. Meany. 1993. Australian experience with individual transferable quota systems. *In* The Use of Individual Quotas in Fisheries Management, Organisation for Economic Co-operation and Development, Paris.

Gilden, J. (ed.). 1999. Oregon's Changing Coastal Fishing Communities. ORESU-O-99-001, Oregon Sea Grant, Oregon State University.

Ginter, J. and B. Muse. 2002. Rights-based fishery management systems in marine fisheries off Alaska. Paper presented at the 2002 IIFET meeting, Wellington, New Zealand.

Hall, M.A. 1995. Strategic issues in managing fishery bycatches. *In* Alaska Sea Grant College Program (ed.), Solving Bycatch: Considerations for Today and Tomorrow. Alaska Sea Grant College Program Report No. 96-03, University of Alaska Fairbanks, Fairbanks.

Halvorsen, R., F. Khalil and J. Lawarrée. 2000. Discussion paper on inshore sector catcher vessel cooperatives in the Bering Sea/Aleutian Islands pollock fisheries. Paper prepared for the North Pacific Fishery Management Council, Anchorage.

Hartley, M. and M. Fina. 2001. Changes in fleet capacity following the introduction of individual fishing quotas in the Alaskan Pacific halibut and sablefish fishery. *In* Shotton, R. (ed.), Case Studies on the Effects of Transferable Fishing Rights on Fleet Capacity and Concentration of Quota Ownership. FAO Fisheries Technical Paper 412, Food and Agriculture Organization, Rome.

Henry, F. 1990. Mesh restrictions: discussion summary. *In* C. Dewees and E. Ueber (eds.), Effects of Different Fishery Management Schemes on Bycatch, Joint Catch and Discards., California Sea, Grant, University of California, La Jolla.

Hoagland, P., D. Jin, P. Lee, C. Croft, L. Davidson and S. Wallis. 1996. Market-Based Incentives to Reduce Fisheries Bycatch. NOAA Contract No. 50-DGNF-5-00172.

Holland, D., and J. C. Ginter. 2000. Common Property Institutions in the Alaskan Groundfish Fisheries. Presented at the Eighth Conference of the International Association for the Study of Common Property, May 31-June 4, Bloomington, ID.

Larkin, M., D. Lowman, B. Pettinger, J. Thomas and R. Young. 2003. The British Columbia Individual Vessel Quota Experience: Lessons for the West Coast Trawl Groundfish Fishery. Report on June 24, 2003 Meeting.

Leal, D.R. 2002. Fencing the Fishery: A Primer on Ending the Race for Fish. Political Economy Research Center, Bozeman, Montana.

Leipzig, P. 2001. Pacific Groundfish Buy-Back Proposal and the Final Summary Analysis. Fishermen's Marketing Association, Eureka, CA.

McElderry, H., D. McCullough, J. Illingworth and J. Schrader. 2002. Electronic Monitoring for Shoreside Hake Fishing: A Pilot Study. Draft. Prepared by Archipelago Marine Research, Ltd., Victoria, B.C.

Matulich, S. and M. Sever. 1999. Reconsidering the initial allocation of ITQs: The search for a Pareto-safe allocation between fishing and processing sectors. Land Economics 75(2):203-219.

Matulich, S. and M. Clark. 2003. North Pacific halibut and sablefish IFQ policy design: Quantifying the impacts on processors. Marine Resource Economics 18(2):149-166.

Murray, S. N., R. F. Ambrose, J. A. Bohnsack, L.W. Botsford, M. H. Carr, G. E. Davis, P. K. Dayton, D. Gotshall, D. R. Gunderson, M. A. Hixon, J. Lubchenco, M. Mangel, A. MacCall, D. A. McArdle, J. C. Ogden, J. Roughgarden, R. M. Starr, M. J. Tegner, M. M. Yoklavich. 1999. No-take Reserve Networks: Sustaining Fishery Populations and Marine Ecosystems. Fisheries 24(11):11-25.

Nash, R. 1989. The Rights of Nature: A History of Environmental Ethics. University of Wisconsin Press, Madison.

National Research Council. 1999. Sharing the Fish: Toward a National Policy on Individual Fishing Quotas. National Academy Press, Washington, D.C.

National Research Council. 2001. Marine Protected Areas: Tools for Sustaining Ocean Ecosystems. National Academy Press, Washington, D.C.

NMFS. 1996. Our Living Oceans: The Economic Status of U.S. Fisheries, 1996. Office of Science and Technology, National Marine Fisheries Service, NOAA, Silver Spring, Maryland.

Oregon Coastal Zone Management Association (OCZMA). 2002. Oregon's Groundfish Fishery Trends, Implications, and Transitioning Plans. Oregon Coastal Zone Management Association, Newport, Oregon.

Oregon State University. 2003. Heads Up!. Summary of the results of the groundfish buyback program, September 30, 2003. Online: www.heads-up.net/upload_files/petes%20pub.doc

Ostrom, E. 1990. Governing the Commons. Cambridge University Press, New York.

Pacific Fishery Management Council. 2004. Acceptable Biological Catch and Optimum Yield Specification and Management Measures for the 2004 Pacific Coast Groundfish Fishery. Draft Environmental Impact Statement and Regulatory Analyses. Pacific Fishery Management Council, Portland, OR.

Parrish, R., J. Seger and M. Yoklavich. 2001. Report: Marine Reserves to Supplement Management of West Coast Groundfish Resources. Phase I. Technical Analysis. Online: www.pcouncil.org/reserves/recent/phase1analysis.html#N_5_

Pascoe, S. 1997. Bycatch Management and the Economics of Discarding. FAO Fisheries Technical Paper No. 370, Food and Agriculture Organization of the United Nations, Rome.

Pearce, D. and D. Moran. 1994. The Economic Value of Biodiversity. Earthscan Publications, Ltd., London.

Pikitch, E. K., D. L. Erickson, and J. R. Wallace. 1988. An evaluation of the effectiveness of trip limits as a management tool. Fisheries Research Institute, School of Fisheries, Univ. of Wash., Seattle, WA. NWAFC Processed Report 88-27.

Radtke, H. D. and S. W. Davis. 1998. Economic Effects to Orgeon's Coastal Economy from Improved Utilization of Marine Fishery Resources. Prepared for the Oregon Coastal Zone Management Association.

Radtke, H. D. and S. W. Davis. 2000. Description of the U.S. West Coast Commercial Fishing Fleet and Seafood Processors. February, 2000. Prepared for Pacific States Marine Fisheries Commission. Portland, OR.

Roheim, C. 2003. Early indications of market impacts from the Marine Stewardship Council's ecolabeling of seafood. Marine Resource Economics 18(1):95-114.

Roy, N. 1996. What went wrong and what can we learn from it? *In* Gordon, D. and G. Munro (eds.), Fisheries and Uncertainty: A Precautionary Approach to Resource Management, University of Calgary Press, Toronto.

Scott, A. 2000. Introducing property in fishery management. *In* R. Shotton (ed.), Use of Property Rights in Fisheries Management. FAO Fisheries Technical Paper 404/1, Food and Agriculture Organization, Rome.

Scholz, A.. 2003. Groundfish Fleet Restructuring Information and Analysis Project: Final Report and Technical Documentation. Pacific Marine Conservation Council/Ecotrust. San Franscisco, CA.

Sladek et al. 1997

Stevens, T., J. Echeverria, R. Glass, T. Hager and T. More. 1991. Measuring the existence value of wildlife: what do CVM estimates really show? Land Economics 67(4):390-400).

Sullivan, J. M. 2000. Harvesting cooperatives and U.S. antitrust law: Recent developments and implications. Presented at International Institute of Fisheries Economics 2000 conference, July 10-15, Corvallis, OR..

Sutinen, J. G., P. Mace, J. Kirkley, W. Depaul, and S. Edwards. 1992. Appendix to L.G. Anderson, Consideration of the Potential Use of Individual Transferable Quotas in U.S. Fisheries. Volume 1. Overview Document. NOAA Contract No. 40AANF101849.

Sylvia, G. and H. Munro. 2003. The Achievements of the Pacific Whiting Conservation Cooperative: Rational Collaboration in a Sea of Irrational Competition. Presented at the Workshop on Cooperatives in Fisheries Management, Anchorage, Alaska, June 2003.

Thomson, C. 1998. Evaluating marine harvest refugia: An economic perspective. *In* M. Yoklavich (ed.), Marine Harvest Refugia for West Coast Rockfish: A Workshop. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-255.

Wheeler, B., J. Bradford, C. Collins, A. Duncan, B.Wilson and H. Young. 1992. Sustainable Fisheries Tiakina nga Taonga a Tangaroa, Report of the Fisheries Task Force to the Minister of Fisheries on the Review of Fisheries Legislation, Ministry of Agriculture and Fisheries, Wellington.

Wilen, J. and E. Richardson. 2003. The Pollock Conservation Cooperative. Paper presented at the Workshop on Cooperatives in Fisheries Management, Anchorage, Alaska, June 2003.

Yoklavich, M. 1998.

Young, R. 2001. Buying Back the Groundfish Fleet. Unpublished manuscript.

Contents